January 1987

YAKIMA RIVER SPRING CHINOOK ENHANCEMENT STUDY

Annual Report 1987

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Annual Report FY 1987

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1.0 ACKNOWLEDGEMENTS

We would like to thank all the members of the Yakima Indian Nation Fisheries Resource Management staff for their suggestions and assistance in the field. Thanks also to Joe Jay Pinkham III, William Fiander, and Lonnie Spencer for maintaining the high quality of data collected in the field. Additional part-time personnel who assisted in the collection of data were Bobby Bobb, Leroy Senator, Hollis Woodward, Matt Goudy, Joe Hoptowit, Barney Tulee, David Franklin, Tammy Swan, Beverly Dogsleep, Thomas Morrison, and Steve Thompson.

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2.0 ABSTRACT

The smolt outmigration was monitored at Wapatox on the Naches River and Prosser on the lower Yakima. The spring outmigration at Wapatox was estimated to be 16,141 smolts. The 1987 spring outmigration of wild spring chinook from the Yakima Basin was estimated to be 251,975 smolts at Prosser.

The survival from egg to smolt was calculated using the 1985 redd counts and the 1987 smolt outmigration at Prosser. The estimated survival was 4.16%, which gives a mean egg to smolt survival over four years of 6.32%.

In 1987 a total of 3,683 adult and 335 jack spring chinook salmon returning to the Yakima River were counted at Prosser fish ladder. This gives a total of 4,018 salmon returning to Prosser Dam. The median dates of passage were May 12 and May 16 for adults and jacks respectively. An additional 372 fish were estimated to have been caught in the Yakima River subsistence dipnet fishery below Horn Rapids and Prosser Dams. Therefore, total return to the Yakima system was 4,390 spring chinook salmon.

Spring chinook were counted at Roza Dam from May 1 to September 30, 1987. Passage at Roza Dam was 1,610 adult and 67 jack spring chinook for a total of 1,677 wild fish. The median dates of passage at Roza Dam were May 29 and May 26 for spring chinook adults and jacks respectively.

The smolt to adult (S_{sa}) survival was calculated based on the 1983 smolt outmigration estimated at Prosser and the 1984

return of jacks (3 year old fish) the 1985 return of four year old adults, and the 1986 return of five year old fish to the Yakima River. It was estimated that 6,012 wild three, four, and five year old fish returned from an estimated smolt outmigration of 135,548 fish in 1983. This gives an estimated survival from smolt to adult of 4.4%.

The smolt to adult survival for the 1984 smolt outmigration was 5.3% with 423 jacks returning in 1985, 5,163 four year old adults returning in 1986, and 983 five year old fish returning in 1987 from an estimated 123,732 smolts in 1984.

Spring chinook adults from fourteen different hatchery release groups were recovered in 1987. A total of 211 coded wire tags were recovered and these were expanded to an estimated 253 returning hatchery fish in 1987. Nine of these fish were jacks.

3.0 INTRODUCTION

The population of Yakima River spring chinook salmon (Oncorhynchus tshawytscha) has been drastically reduced from historic levels reported to be as high as 250,000 (Smoker, 1956). This reduction is the result of a series of problems including mainstem Columbia dams; dams within the Yakima itself; severely reduced flows due to irrigation diversions; outmigrant loss in irrigation canals; increased thermal and sediment loading; and overfishing. Despite these problems, the escapement of spring chinook to the Yakima River has continued at levels ranging from 166 to 9,442 since 1957.

In October, 1982, the Bonneville Power Administration contracted the Yakima Indian Nation to develop methods to increase production of spring chinook in the Yakima System. The Yakima Nation's current enhancement policy attempts to maintain the genetic integrity of the spring chinook stock native to the Yakima Basin. Relatively small numbers of hatchery fish have been released into the basin in past years. Data from the Wenatchee System indicate a return rate from hatchery smolts of less than .25% (Mullan, 1982). Return rates from the current Yakima study smolt releases are .07%. These low return rates indicate that few fish would have returned from these early hatchery releases. Thus the genetic input from hatchery fish into Yakima Basin stocks is probably negligible.

The goal of this study is to develop data that will be used to present management alternatives for Yakima River spring

chinook. The study has five major objectives. The first objective is to determine the distribution, abundance and survival of wild Yakima River spring chinook. Naturally produced populations are being studied to determine if these runs can be sustained in the face of present harvest and environmental conditions. Survival through each life stage is being evaluated in an attempt to determine limitations to natural production in the basin. Survival to emergence studies are being conducted to determine survival through the incubation stage. Analysis of the relationship between survival to emergence and gravel substrate quality is being undertaken. Seining at selected sites and electroshocking surveys have been conducted to evaluate distribution and abundance of juvenile fish. Smolt outmigrations are monitored at the Wapatox juvenile trap on the Naches River and at the Prosser juvenile trap on the mainstem Yakima River. Adult returns are determined by monitoring the Yakima Tribal dipnet fishery, counting adults at Prosser and Roza fish ladders, and through spawning ground surveys. Physical parameters such as water temperatures and stream flow are monitored throughout the basin.

The second major objective of this study is to determine the relative effectiveness of different methods of hatchery supplementation. This objective is divided into three sub-objectives:

a) Determination of optimal release time Smolt releases are the norm, but fingerlings were released in June, September, and November of 1984 and 1985. Downstream survival of these smolts

was evaluated and adult returns are being monitored.

b) Determination of optimal manner of release In the past, fish have either been transported from a hatchery and released into the Yakima River, or raised in rearing ponds. These methods, as well as the use of acclimation ponds, will be evaluated.

c) Determination of optimal release stocks Smolts were released in 1986 and 1987 as hatchery X hatchery, hatchery X wild, and wild X wild crosses to determine the effect of genetic makeup on the success of various releases. Success will be measured as the number of adults returning, as well as whether spawning timing is similar to the wild stock.

Adverse interactions between hatchery releases and wild stocks were minimized by scatter-planting hatchery fish so densities in the river remained low enough to minimize competition for food and space.

The last three major objectives of the study are:

3) to locate and define areas in the watershed which may be used for the rearing of spring chinook;
4) to define strategies for enhancing natural production of spring chinook in the Yakima River; and
5) to determine the physical and biological limitations on production within the system.

These objectives will be met at the end of the study when the database is complete.

This project is a multi-year undertaking that will evaluate different management and enhancement strategies. At the conclusion of this study, a series of alternatives will be

developed that can be used to determine how best to enhance the runs of spring chinook in the Yakima Basin. Annual reports were presented for 1983 (Wasserman and Hubble, 1983), 1984 (Wasserman, Hubble, and Watson, 1985), 1985 (Fast, Hubble, and Watson, 1986) and 1986 (Fast, Hubble, and Watson, 1986). A detailed description of methods and materials used in this study can be found in these earlier reports. This current report is concerned with new findings in 1987 and some re-evaluation of previous data in light of current information.

4.0 DESCRIPTION OF STUDY AREA

The Yakima River is located in central Washington and flows 217 miles from its headwaters in the Cascade Mountains (elevation 2,448 ft) to the Columbia River near Richland at river mile (RM) 335 (Figure 1). The Yakima River Basin drains 6,155 square miles of the east slopes of the Cascade Mountains in Kittitas and Yakima Counties. The Yakima River flows east and south through the Kittitas Valley from its ruggedly glaciated headwaters. South of the valley the river cuts through Manastash and Umtanum ridges in a deep canyon. The river enters the middle valley above Yakima through a gap cut in Selah Ridge and leaves through Union Gap in Ahtanum Ridge. Rattlesnake Hills, crossing eastern Yakima and northern Benton Counties, and the Horse Heaven Hills to the south are prominent features bordering the lower river in its 80 mile reach from Union Gap to the Columbia River. The Yakima River enters the Columbia River near Richland at an elevation of 300 feet.

The major tributaries, with the exception of Satus and Toppenish Creeks, enter the river above the city of Yakima. The Naches River is the largest tributary, entering the Yakima at RM 101 and extending 51 miles to the junction of the Bumping and Little Naches Rivers. The Naches River drains an area of 1,106 square miles. Other important tributaries of the Naches include the American and Tieton Rivers and Rattlesnake Creek.

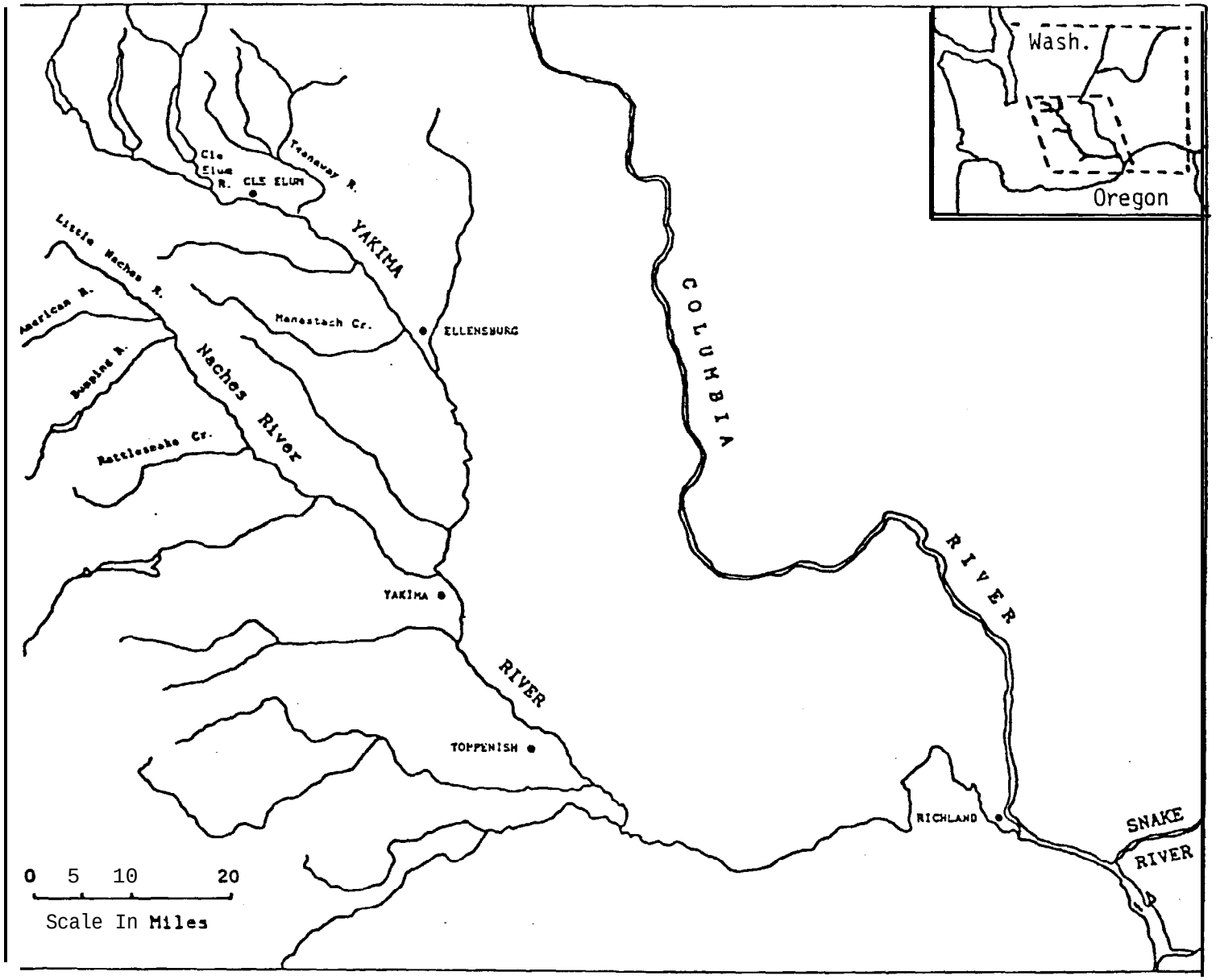

Figure 1. The Yakima River Basin in south-central Washington.

Important tributaries in the upper Yakima are the Teanaway and Cle Elum Rivers. Numerous creeks, including Manastash, Taneum, and Swauk, flow into the Yakima in the Kittitas Valley. The climate of the Yakima Basin varies from wet-alpine in the Cascade Mountains to semi-arid conditions at the lower elevations. The crest of the mountains receive 80 to 140 inches of precipitation per year while approximately one third of the basin receives ten inches or less. Summer temperatures average 55 F in the mountains and 82 F in the valleys. During the winter monthly maximum temperatures range from 25 F to 40 F and low temperatures range from -20 F to -25 F.

The Yakima River Basin produces 3.5 million acre feet average annual runoff, unregulated. The U.S. Bureau of Reclamation's Yakima Irrigation Project has transformed the semi-arid region into a productive agricultural region. Approximately 500,000 acres are presently under irrigation, consuming 2.25 million acre feet each year. There are numerous dams and irrigation diversions on the river. These include Horn Rapids, Prosser, Sunnyside, Wapato, Roza, and Easton. A screening structure is associated with each of these dams except at Easton. For an extensive description of the Yakima Basin, see Bryant and Parkhurst (1950).

In the Yakima system, reservoir storage acts to regulate flows. Man-made Kachess, Keechelus, and Cle Elum Lakes in the upper Yakima and Bumping and Rimrock Lakes on the Naches system are the major storage sites. These storage areas supplement flows during the irrigation season (March-October) and store water in the winter. Irrigation and power diversions generally reduce

flows in the lower sections of the Yakima River. Sunnyside and Wapato dams near rivermile 108 divert approximately one-half the total river flow at each site into irrigation diversions in the summer and fall. Prosser diversion removes approximately 1,400 cfs for irrigation and power production throughout most of the year. Due to the large irrigation diversions at Prosser and Parker, flows drop dramatically in the lower river from June to October. Approximately 50% of the flows withdrawn at diversion sites re-enter the river downstream after being used for irrigation or hydropower.

Prior to 1980, flows remained high on the spawning grounds in September and October for irrigation purposes. Many fish that spawned at this time deposited their eggs in shallow water near the bank. When flows were decreased at the end of the irrigation season, these redds were often dewatered. Following court action in 1981 the irrigation flows were decreased in the Yakima branch during the first week of September so that this problem would not continue. To offset the reduction of flows from the upper Yakima in September, flow is increased in the Naches River mainly from Rimrock Reservoir releases. This increased flow enters the Naches River below the areas where most spring chinook spawning occurs so it is not believed to impact spawning success.

5.0 METHODS AND MATERIALS

5.1 NATURAL PRODUCTION

5.1.1 SURVIVAL TO EMERGENCE STUDIES

5.1.1.1 Fry Trapping

In the fall of 1986 a total of seven spring chinook redds were selected to be capped for survival from egg to fry studies. The females associated with each redd were collected and the length fecundity model developed in 1986 was used to estimate the number of eggs deposited in each redd. The redds were capped in February of 1987 and early emerging fry were collected and counted. However, due to extremely high runoff during the spring snowmelt the traps were not checked for a period of approximately six weeks. When the flood waters receded the emergence nets were clogged with sand and gravel and the live boxes of several traps had been lost due to high flows. Due to the incomplete record of fry emergence in 1987 no analysis or reporting of survival to emergence data will be included in this annual report.

5.1.2 WINTER DISTRIBUTION STUDIES

Electroshocking for juvenile spring chinook was conducted October 23 through January 8, from RM 181 downstream to RM 20 on the Yakima River. The purpose was to determine; (1) winter habitat selection by juvenile spring chinook, and (2) distribution of branded wild spring chinook that had been released at Wapatox smolt trap (RM 17) on the Naches River during the fall.

A Smith-Root SR-14 electroshocker was used for collection. Sampling sites ranged from 1/2 mile in length to several miles. General sampling proceedures consisted of moving downstream with the current in a zig-zag pattern between the stream bank and the thalwag.

Fish collected were anesthetized with MS-222. Fork lengths were recorded from all fish. Fish were checked for brands and then were returned to the river after recovery. A general description of the habitat type in which fish were found was recorded for each sampling location.

5.1.3 PROSSER SMOLT TRAP

Prosser smolt trap was operated continuously from March 9 to July 31, 1987. Prosser trap operates from a bypass pipe that shunts fish from rotary drum screens in Chandler Canal back to the mainstem Yakima River. In 1984, 1985, 1986 and 1987 trapping efficiency (the percentage of outmigrants passing Prosser Dam diverted into the trap) was calculated via a series of releases of marked fish. The statistical methodology for efficiency calculations was evaluated by Douglas Chapman of the University of Washington Center for Quantitative Science. A detailed description of the evaluation process can be found in Appendix B of the 1986 BPA annual report. The basic procedure was as follows. Once each week, fish captured in the trap during the night were cold-branded. Two groups were branded differently, with one group released two miles upstream of the canal intake, and the other in the canal. Efficiency (E_i) was based on the recapture rate of branded fish as follows:

$$E_i = \frac{C_{ri}}{R_{ri}\ (C_{ci}/R_{ci})}$$

where E_i = fraction of fish diverted into the canal in the ith experiment;
R_{ci} = number released directly into the canal in the ith experiment;
R_{ri} = number released directly into the river in the ith experiment;
C_{ci} = number recaptured from the canal release in the ith experiment;
and C_{ri} = number recaptured from the river release in the ith experiment.

During the 1984, 1985, 1986 and 1987 spring chinook smolt migrations a total of 68 separate efficiency tests were performed.

A relationship was developed between the combined 1984-87 efficiency data and river discharge. This relationship was then used to estimate the total number of juvenile fish passing Prosser dam in each of the years the trap was operating. The confidence intervals for the calculated total smolt passage for each year was estimated from a linearized form of the logistic equation $Y = 1/1+E^{(-A+BX)}$. Lengths, weights and scales were taken from random samples of all species and release groups on a daily basis. In addition unbranded ad-clipped hatchery spring chinook were sacrificed for coded wire tag analysis on a daily basis.

5.1.4 WAPATOX SMOLT TRAP

The purpose of Wapatox smolt trap is to monitor the spring chinook smolt outmigration in the spring and the pre-smolt outmigration the rest of the year from the Naches subbasin. Wapatox smolt trap is located on the Naches River at RM 17, just downstream from the confluence of the Tieton and Naches Rivers (see Figure 1). The trap is constructed on the Wapatox by-pass canal. Fish entering the canal are shunted into a by-pass pipe (culvert) by a series of rotating drum screens across the diversion canal.

The 1986 fall trapping of spring chinook pre-smolts ceased December 1, 1986 when the screens were removed from Wapatox Diversion Canal. Wapatox smolt trap began operation on April 1, 1987 when the rotary drum screens were put into place. The trap was normally checked at least 5 times per week and more often during peak migration periods. Only salmonid species were enumerated. Fish were anesthetized with MS-222 and fork lengths and weights were recorded.

Test releases were made to determine trap efficiency as an empirical function of the percent discharge diverted into the canal (P.D.C.). Three successful tests were conducted using both spring chinook and hatchery coho. The P.D.C. ranged from 16.7% to 28.6% over the coarse of the three tests. Canal test fish were released at the head of the canal which is approximately 400 meters from the screens. River test fish were released approximately 1/2 mile upstream to the dam. Refer to the 1986 BPA

annual report (Appendix B) for an indepth discussion on calculation of the trap efficiency.

The P.D.C. efficiency data from the three tests were fitted to a linear equation. The resulting trap efficiency equation was used to estimate daily smolt outmigration. Fall and summer outmigration estimates were calculated, as in previous years, assuming that trap efficinecy was directly correlated to P.D.C. This methodolgy was used for estimation of the summer and fall outmigation because the P.D.C.'s were generally outside of the tested range.

When the trap was inoperable, an estimate of the daily catch was made by interpolation of daily catches preceding and following these periods.

5.1.5 ADULT RETURNS

Adult spring chinook salmon harvested below Prosser in the 1987 Yakima Tribal ceremonial dipnet fishery were monitored under the BIA 638 contract.

The Prosser and Roza Dam adult fish counting stations were monitored in 1987. Counting at Prosser began April 1 and continued through September. Roza Dam was monitored from May 1 through September 30. Water clarity at Roza Dam was such that fish swimming over the counting board could be visually examined for the presence or absence of an adipose fin. All adipose-clipped fish were collected in a second trap and sacrificed to recover the coded wire tags.

Spawning ground surveys were inititated on the American River in mid-July under a contract from the U.S. Canada Treaty. The Yakima Indian Nation was the lead agency under a contract from the Columbia River Inter-Tribal Fish Commission. Spawning ground surveys were conducted throughout each reach of spawning area once each week. All carcasses were examined for adipose fins, and fork length and mid-eye to hypural plate length were recorded. Scale samples were taken, and gonads were examined to determine sex and egg retention in females. Following examination the tail of each fish was removed so it would not be examined more than once.

5.1.6 ESTIMATES OF SURVIVAL THROUGH VARIOUS LIFE STAGES

5.1.6.1 Egg to fry:

As previously discussed, survival from egg deposition to emergence was not completed in 1987. Total egg deposition was calculated as mean fecundity of Yakima River females (based on the length fecundity model) multiplied by the number of redds located on the spawning grounds.

The total number of fry produced (F) was calculated as:

F = mean fecundity of Yakima River spawners x number of redds
X survival from egg deposition to emergence.

5.1.6.2 Egg to Smolt:

Survival from egg to smolt (S_{es}) was calculated as:

$$S_{es} = \frac{\text{estimated number of smolts at Prosser}}{\text{total egg deposition for year class.}}$$

5.1.6.3 Fry to Smolt:

Survival from fry to smolt (S_{fs}) was estimated as:

$$S_{fs} = \frac{\text{number of smolts estimated to pass Prosser}}{\text{fry for year class}}$$

Estimates of egg deposition and fry production were made for 1981 to 1987 based on redd counts from spawning ground surveys. Survival from egg to smolt and from fry to smolt were based on 1981, 82, 83, 84, and 85 redd counts and 1983, 84, 85, 86, and 87 smolt outmigration estimates at Prosser.

5.1.6.4 Smolt to Adult:

The complete smolt to adult survival (S_{sa}) of wild spring chinook salmon in the Yakima system was calculated from the 1983 and 1984 smolt outmigration estimated at Prosser and the return of jacks (3 years old fish), four year old adults, and five year old adults corresponding to each years smolt run. The jack and four year old adults (two ocean fish) returning in 1986 and 1987 respectively, from the 1985 smolt outmigration were also analysed for this report.

PART 2

5.2 HATCHERY OPERATIONS

5.2.1 OUTPLANTING STUDIES

5.2.1.1 Smolt Releases

The effectiveness of hatchery-reared "native" (wild x wild) and "hybrid" (wild x hatchery) vs. "hatchery" (hatchery x hatchery) smolts was assessed by transporting three such groups to Mary's pond (RM 192 on the Yakima River) and allowing them immediate volitional release. Fish were transported from Leavenworth National Fish Hatchery and stocked into the pond over the period March 19 through March 23, 1987. Release began April 14, 1987. Similar releases were made from Mary's pond in 1986. A second group of hatchery x hatchery smolts was transported from Leavenworth National Fish Hatchery and released directly into the upper Yakima River (12 sites between RM 155 and 200) on April 13, 1987. All fish released in 1987 were coded-wire tagged, and approximately 13% of the pond fish and 12.6% of the fish released directly into the river were freeze branded.

Counts of branded hatchery smolts captured at Prosser smolt trap were used to evaluate freshwater survival of both groups of fish. Based on brand recoveries alone the relative survival of each group was calculated. Total estimated passage of each group yielded absolute survival rate estimates to Prosser. Smolt to

adult return rates of these two groups will be determined from the 1987, 1988, 1989 and 1990 captures of tagged fish in the ocean, mainstem Columbia River fisheries, the tribal dipnet fishery on the Yakima River, collections at Roza Dam, and from carcass recoveries on the spawning grounds.

5.2.2 BROOD STOCK EVALUATIONS

Hatchery spring chinook introduced into the Yakima River from 1958 to 1987 have come from numerous sources and stocks (Table 1), although, as previously mentioned, their contribution to the genome of naturally spawning Yakima River fish has probably been minimal. An experimental brood stock program was undertaken in 1984 and continued in 1985 to evaluate the benefits of using spring chinook from the Yakima River as a source of gametes. The purpose was to culture indigenous fish and to determine the optimal stock for enhancement programs.

The best stock for enhancement programs will be determined by a comparison of returns of adult fish from four release groups: (1) a pond-acclimated group of hatchery-reared "hybrids" (Yakima River males crossed with Leavenworth Hatchery females), (2) an acclimated group of hatchery-reared "natives" (Yakima males crossed with Yakima females), (3) an acclimated group of pure hatchery smolts (Leavenworth males crossed with Leavenworth females), and (4) a group of pure hatchery smolts released directly into the river. Groups 1-3 were allowed volitional release from an acclimation pond in the upper Yakima River. These groups will be used to determine if cultured fish that are the progeny of Yakima River spring chinook have a greater success in returning to the Yakima River than do non-indigenous stocks. The fourth group will be used as a control on the value of acclimating spring chinook in ponds for various periods before allowing volitional release. Returns from group four will be compared directly to group three.

Table 1. Historical plants of spring chinook in the Yakima River Basin.

Brood year	Release date	Hatchery	Size fish/Lb	Number released	Brood stock	Release location
1958	8/59	Klickitat	143	20,000	Klickitat	Yakima River
1960	5/61	Leavenworth	330	18,000	Icicle	Yakima River
1961	2/62	Leavenworth	1000	5,000	Icicle	Yakima River
1962	12/62	Leavenworth	1000	5,000	Icicle	Yakima River
1962	63			12,500		Nile Springs
1963	64			10,000		Nile Springs
1971	6/73	Klickitat	58	162,400	Klickitat	Naches River
1971	6/73	Klickitat	58	162,400	Klickitat	American River
1974	75			8,580		Nile Springs
1974	4/76	Ringold	3	7,230	Ringold	Nile Springs
1974	9/76	Klickitat	29	42,775	Klickitat	Nile Springs
1975	3/77	Klickitat	19	13,300	Klickitat	Nile to Richland
1976	3/78	Klickitat	7	2,462	Cowlitz	Nile Springs
1977	4/79	Carson	20	50,000	Carson	Yakima River
1977	4/79	Klickitat	12	25,000	Cowlitz	Nile Springs
1978	4/80	Klickitat	10	24,000	Klickitat	Nile Springs
1978	4/80	Leavenworth	18	30,260	Carson	Yakima River
1979	4/81	Klickitat	14	33,616	Klickitat	Nile Springs
1979	4/81	Leavenworth	20	400,221	Leavenworth	Yakima River
1980	4/82	Leavenworth	14	100,050	Leavenworth	Nile Springs
1980	4/82	Leavenworth	15	401,714	Leavenworth	Yakima River
1981	4-5/83	Leavenworth	18	103,110	Leavenworth	Nile Springs
1981	4/83	Leavenworth	19	97,012	Leavenworth	Yakima River
1982	4/84	Entiat	19	29,636	Carson	Nile Springs
1982	4/84	Entiat	25	42,552	Carson	Yakima River
1983	6/84	Leavenworth	66	102,837	Carson	Yakima River
1983	9/84	Leavenworth	25	102,833	Carson	Yakima River
1983	11/84	Leavenworth	22	108,305	Carson	Yakima River
1983	4/85	Leavenworth	18	50,000	Carson	Yakima River
1984	6/85	Leavenworth	66	100,000	Leavenworth	Yakima River
1984	9/85	Leavenworth	25	100,000	Leavenworth	Yakima River
1984	11/85	Leavenworth	22	100,000	Leavenworth	Yakima River
1984	3/86	Leavenworth	21	51,846	Carson	Yakima River
1984	4/86	Leavenworth	20	50,657	Carson	Yakima River
1984	3/86	Leavenworth	17	46,476	Carson/Yakima	Yakima River
1984	3/86	Leavenworth	17	33,052	Yakima	Yakima River
1985	3/87	Leavenworth	21	42,436	Carson	Yakima River
1985	3/87	Leavenworth	17	44,899	Carson/Yakima	Yakima River
1985	3/87	Leavenworth	17	47,576	Yakima	Yakima River
1985	4/87	Leavenworth	20	42,796	Carson	Yakima River

Note: Native spring chinook broodstock in Klickitat River at times was supplemented with Carson, Cowlitz, Eagle Creek, and Willamette Fish.

5.2.3 ADULT HATCHERY RETURNS

Fourteen groups of adult hatchery fish returned to the Yakima River in 1987. Coded-wire tags were recovered from four sources; the Yakima Indian Nation Zone 6 ceremonial and subsistence fishery in the Columbia River, the Yakima dip net fishery, the spawner surveys and carcass recovery surveys in the Naches River, and f rom the adult trap at Roza Dam. All tags recovered were expanded by the sample rate (fish sampled/total number of fish caught for a fishery or carcasses sampled/total number of spawners estimated in each river for spawner surveys) and by the mark rate or coded-wire tag retention rate.

Survival rate for hatchery smolt to adult was calculated by dividing the total expanded return of adults from each release by the estimated passage of smolts by Prosser from that release. The expanded return numbers were also divided by the total number of smolts released in each group to obtain a hatchery planting to adult survival rate.

6.0 RESULTS AND DISCUSSION

6.1 NATURAL PRODUCTION

6.1.1 SURVIVAL TO EMERGENCE STUDIES

Results of survival to emergence studies will not be presented due to extremely high spring runoff preventing data collection during much of the emergence period.

6.1.2 WINTER DISTRIBUTION STUDIES

Electroshocking studies were conducted from October 23, 1986 through January 8, 1987 to determine the instream movement, distribution, and habitat selection of spring chinook juveniles during the winter. Results showed that (1) fish found above Roza Dam (RM 128) were generally smaller (mean fork lengths ranged from 92 to 97 mm) than fish found below Sunnyside Dam (RM 104), where mean fork lengths ranged from 95-118 mm; (2) Fish above Roza Dam were generally associated with instream cover- under large substrate, root wads, and undercut banks; whereas fish below Sunnyside Dam were generally observed near the stream bottom in riffles and runs with slow velocities (Table 2).

A total of 19,867 wild spring chinook juveniles were branded as they moved downstream past Wapatox Dam between October 22 and December 3, 1986 (see section 6.1.4). Twenty-four brand recoveries from wild spring chinook released at Wapatox smolt trap (RM 17)

were made between Sunnyside Dam (RM 104) and the confluence of Satus Creek (RM 70). Though it's not known what portion of branded fish moved from the Naches River into the Yakima River, these results indicate that fish collected in the fall outmigration at Wapatox are moving a substantial distance downstream into the lower Yakima River in a relatively short period of time. Three fish were found 63 miles downstream from Wapatox Dam only nine days after being released.

Table 2. Winter distribution of spring chinook in the Yakima River, 1986/87.

Location	Date	Mean length(mm)	Habitat type	Velocity (ft/sec)	Depth (ft)
Cle Elum (RM 180)	1-06-87	92	large rock, rip-rap and root-wads	<1.0	3-6
Thorp (RM 165)	12-15-86	96	stream banks and large rocks	<1.0	2-4
Ellensburg (RM 156)	10-16-86	93	stream banks, root wads and substrate	<1.0	2-4
Roza pool (RM 128)	12-17-86	97	large rock, substrate 1-2" dia. and riffles	1-3	1-3
Union Gap (RM 108)	1-07-87	98	stream run, in the and stream column	2-3	5-8
Parker Dam (RM 104)	12-02-86	99	stream banks, substrate and stream column	<1.0	2-4
Toppenish (RM 94)	10-23-86	102	stream runs, in the and stream column	4-8	2-4
Zillah (RM 91)	11-13-86	111	stream runs, in the and stream column	4-8	2-4
Marion Drain (RM 83)	12-17-86	115	stream banks	1-2	2-3
Granger (RM 85)	12-09-86	103	stream run, fish associated with bottom	<1.0	1-2
Granger (RM 81)	12-09-86	108	stream run, in and stream column	2-3	3-5
Satus area (RM 81)	12-12-86	109	runs, associated with stream bottom	<1.0	3-5
Satus area (RM 76)	12-12-86	118	runs, associated with stream bottom	<1.0	1-2
Horn Rapids (RM 19)	12-19-86	112	stream banks, substrate 1-3" dia. cobble	<1.0	1-3
Horn Rapids (RM 19)	1-08-87	114	stream banks, subtrate 1-3" dia. cobble	<1.0	1-3

6.1.3 PROSSER SMOLT TRAP

Smolt outmigration was estimated from a logistic relationship between percent river diversion and percent entrainment (Fast et. al., 1985). A new logistic relationship was fit to data from test releases made in 1984, 1985, 1986 and 1987. This relationship was used to estimate 1987 outmigration and to "re-estimate" outmigration for 1983-1987 (Appendix B of the 1986 BPA annual report). Test releases will be made throughout the duration of the project. The diversion-entrainment relationship will be refined and the outmigration of previous years re-estimated on a yearly basis.

6.1.3.1 Winter Movement

Prosser smolt trap was operated November 1, 1986 through February 28, 1987 (estimated passage was interpolated for the two periods 11/1-13 and 2/10-28) in an attempt to determine the number of juvenile spring chinook moving downstream past Prosser Dam during the winter months. The estimated outmigration of juvenile spring chinook was 78,348 (Table 3). Spring chinook outmigrants branded at Wapatox in the fall of 1986 represented 7.6% of this total.

The mean length, weight and condition factor of unbranded chinook all declined slightly from November through January. In February the mean length and weight, but not the condition factor, increase substantially (Table 4). Mean length and weight figures

Table 3. Estimated weekly outmigration of juvenile spring chinook and branded Naches River spring chinook at Prosser trap from November 14, 1986 through February 9, 1987.

Period of estimation	Total spring chinook	Branded Naches River spring chinook
11/01/86-11/13/86[a]	2,419	24
11/14/86-11/21/86	2,656	26
11/22/86-11/30/86	459	0
12/01/86-12/07/86	17,180	354
12/08/86-12/14/86	11,290	414
12/15/86-12/21/86	3,114	135
12/22/86-12/31/86	2,470	73
01/01/87-01/07/87	917	29
01/08/87-01/14/87	2,450	104
01/15/87-01/21/87	3,626	155
01/22/87-01/31/87	2,726	94
02/01/87-02/07/87	8,623	99
02/08/87-02/09/87	2,850	31
02/10/87-2/28/87[a]	17,111	184
Total	78,348	1,736

[a]estimated passage based on interpolation.

Table 4. Monthly mean lengths, weight and condition factors for wild spring and branded Naches River spring chinook captured at Prosser trap November 14, 1986 through February 9, 1987.

Group	November fork length (mm)	November weight (gm)	November condition factor[a]	December fork length (mm)	December weight (gm)	December condition factor[a]	January fork length (mm)	January weight (gm)	January condition factor[a]	February fork length (mm)	February weight (gm)	February condition factor[a]
					Spring chinook							
Unbranded chinook	119 n=1723	19.8 n=689	11.4 n=689	116 n=7334	16.9 n=3672	10.6 n=3672	114 n=3809	16.2 n=2074	10.4 n=2074	121 n=1549	18.6 n=570	10.4 n=570
Naches chinook	107 n=15	14.7 n=2	10.5 n=2	105 n=820	12.4 n=198	10.2 n=198	107 n=222	12.1 n=117	10.0 n=117	113 n=88	15.7 n=21	10.5 n=21

[a]Estimated as (W/L 3) x 1,000,000 where w = weight in grams and L = fork length in millimeters.

for unbranded chinook were significantly greater (protected LSD, L=0.01) than comparable figures for branded Wapatox chinook in each of the four months monitored. The mean monthly condition factor of unbranded chinook was also greater than the mean condition factor of branded Wapatox chinook in all months but February, although the differences were significant only in December and January.

The estimated outmigration from November 1 through February 28 of Naches River juvenile spring chinook branded at Wapatox was 1,736 fish. This represents 8.7% of the total number of fish branded and released at Waptox. It was estimated from expanded data that 41.1% of the branded Wapatox fish migrated past Prosser during the winter (November 1 - February 28), while the remainder outmigrated as spring smolts.

Based on the estimated smolt outmigration of 251,975 this spring, the number of total spring chinook juveniles outmigrating past Prosser from November 1 through February 28 (57,803) constituted 18.7 percent of the total brood year production. It should be noted that this figure is conservative since the trap was not in operation through parts of October, November and February. These winter outmigrants could represent a significant contribution to total production.

Previous estimates of egg to smolt survival for spring chinook in the years 1983-1986 (Fast et. al., 1986) do not include winter outmigrants and thus probably underestimate smolt production. This winter's outmigration of 57,803 spring chinook will boost the total egg-to-outmigrant survival rate about 24

percent, from 4.16 to 5.45 percent.

Even with current knowledge of the spring outmigration, the long-term seasonal distribution of outmigrants will remain speculative until the contribution of winter fish to total brood year production has been determined. The winter run contribution to total smolt production varies both among rivers and between years in other Northwest basins. In the Lemhi River in Idaho the winter run comprises a fairly constant 50 percent of the total (Bjornn, 1971) whereas in the Warm Springs River in Oregon, the relative sizes of the winter and spring runs vary dramatically from year to year (Stainbrook et. al., 1985).

It would appear that winter outmigrants of spring chinook originate in all parts of the Yakima system, or at the least, not exclusively from the Naches River. Of the 19,867 spring chinook branded and released at Wapatox the fall of 1986, an estimated 1,736, or 8.7 percent, subsequently migrated to Prosser. The recovery rate of branded fish should have been much greater if the majority of fish observed at Prosser were leaving the Naches River. Furthermore, there was a highly significant size difference between branded (Naches River) and unbranded chinook, with the Naches fish being 7 to 10 percent smaller than unbranded fish. This size difference implies that the larger fish originate in the upper Yakima.

There are two pieces of evidence to suggest that in the main river, larger chinook undertook winter migrations while smaller chinook remained in upriver rearing areas. First, data collected while sampling the Yakima River in an electroshocking boat between

October 23 and January 8 indicated that smaller fish were found above Roza Dam (Rm 128) than below (see section 6.1.2). Mean fork lengths for the upriver fish ranged from 92-97 mm whereas mean length of downriver fish ranged from 95-118 mm. Upriver fish were generally found under large substrate or among undercut banks and root-wads. Downriver fish were generally found on the bottom of slow runs and riffles. Second, the mean length of chinook branded at Wapatox was significantly less than the mean length of unbranded fish at Prosser. Either significantly more small branded fish died in route to Prosser, or all fish grew 12-16 mm between October 22 and February 9. While none of these possible explanations can be dismissed, these explanations are relatively unlikely in winter.

6.1.3.2 Spring Movement

A total of 451,370 salmonids were counted at Prosser smolt trap March 1 through July 31, 1987. The total catch included 139,384 wild spring chinook, 95,505 wild fall chinook, 25,227 hatchery spring chinook, 50,546 hatchery fall chinook, 43,419 wild steelhead, 10,825 hatchery steelhead, 511 hatchery rainbow trout and 85,953 hatchery coho.

6.1.3.3 Wild Salmonids

Total estimated outmigration of salmonids is presented in Table 5.

Table 5. Outmigration for 1987, Prosser smolt trap.

Dates	Wild spring chinook	Wild fall chinook	Hatch. spring chinook	Hatch. fall chinook	Wild steelhead	Hatch. steelhead	Trout	Hatch. coho	Wapatox fall parr	Trucked BxH chinook smolts	Acclimated BxH chinook smolts	Acclimated BxW chinook smolts	Acclimated WxW chinook smolts
3/9-3/14													
3/15-3/21	1,589	0	0	0	7,452	0	0	0	35	0	0	0	0
3/22-3/31	2,036	0	27	0	1,337	17	0	0	13	0	0	0	0
Subtotal	7,232	0	27	0	15,316	17	0	0	57	0	0	0	0
4/1-4/7	21,387	65	254	0	3,291	22	6	0	274	0	0	0	0
4/8-4/14	32,646	130	774	0	4,422	441	1	114	387	1	12	11	6
4/15-4/21	51,264	259	4,573	0	9,822	672	0	729	964	342	42	35	17
4/22-4/30	90,569	17,379	24,899	0	26,467	6,186	216	33,779	699	1,342	68	211	49
Subtotal	195,866	17,833	30,500	0	44,002	7,321	223	34,685	2,324	1,685	122	257	72
5/1-5/7	20,848	22,486	19,693	306	12,487	2,946	6	9,649	14	201	46	179	49
5/8-5/14	12,814	42,492	9,952	14,735	13,450	12,661	404	85,928	52	53	15	140	25
5/15-5/21	3,082	11,883	354	23,568	2,919	1,202	130	36,929	0	0	0	2	0
5/22-5/31	4,418	15,098	440	14,729	6,189	3,352	153	29,739	7	1	2	21	0
Subtotal	41,162	91,959	30,439	38,603	35,045	17,215	693	162,245	73	255	63	342	74
6/1-6/7	2,732	20,819	27	13,738	1,878	693	24	1,716	24	0	0	2	0
6/8-6/14	3,328	16,550	2	10,417	799	276	16	277	16	0	0	0	0
6/15-6/21	451	8,230	0	3,416	300	126	11	86	11	0	0	0	0
6/22-6/30	311	1,576	1	237	44	27	a	a	a	0	0	0	0
Subtotal	4,090	47,175	30	27,808	3,021	1,122	60	2,087	60	0	0	2	0
7/1-7/7	0	236	0	6	4	6	28	0	0	0	0	0	0
7/8-7/14	0	205	0	1	3	1	36	0	0	0	0	0	0
7/15-7/21	0	176	0	0	3	0	6	0	0	0	0	0	0
7/22-7/31	0	108	0	0	0	0	1	0	0	0	0	0	0
Subtotal	0	725	0	7	10	7	71	0	0	0	0	0	0
Season	248,350	156,967	60,996	66,418	97,384	25,682	1,047	199,021	2,454	1,940	185	601	146

Estimated outmigration of wild spring chinook, fall chinook and steelhead smolts was 251,975, 157,692 and 105,969 respectively. Estimated outmigration of hatchery spring chinook, fall chinook, steelhead and coho was 61,005, 66,418, 25,682 and 199,021 respectively.

Estimated outmigration of wild spring chinook smolts in the months March through June was 10,857, 195,866, 41,162 and 4,090, respectively. No fish were counted in July. The week of highest smolt outmigration occurred April 22-30, when 90,569 smolts outmigrated (Figure 2). The date of median passage was April 23, 1987.

The estimated egg to smolt survival for wild spring chinook was 4.16% (Table 6). This was calculated strictly upon the estimated spring outmigration in relation to estimated egg deposition.

Table 6. Estimated outmigration of wild salmonid smolts at Prosser Dam, 1983-1987, and estimated egg to smolt survival for wild spring chinook. (Uncorrected for intra-canal mortality.)

Year	Wild spring chinook	Egg-to-smolt survival wild spring chinook	Wild fall chinook	Wild steelhead
1987	251,975	4.16	157,581	105,968
1986	180,789	6.01	33,038	108,013
1985	83,614	5.78	64,628	62,493
1984	123,732	6.38	39,140	75,645
1983	136,102	9.26	99,752	79,060

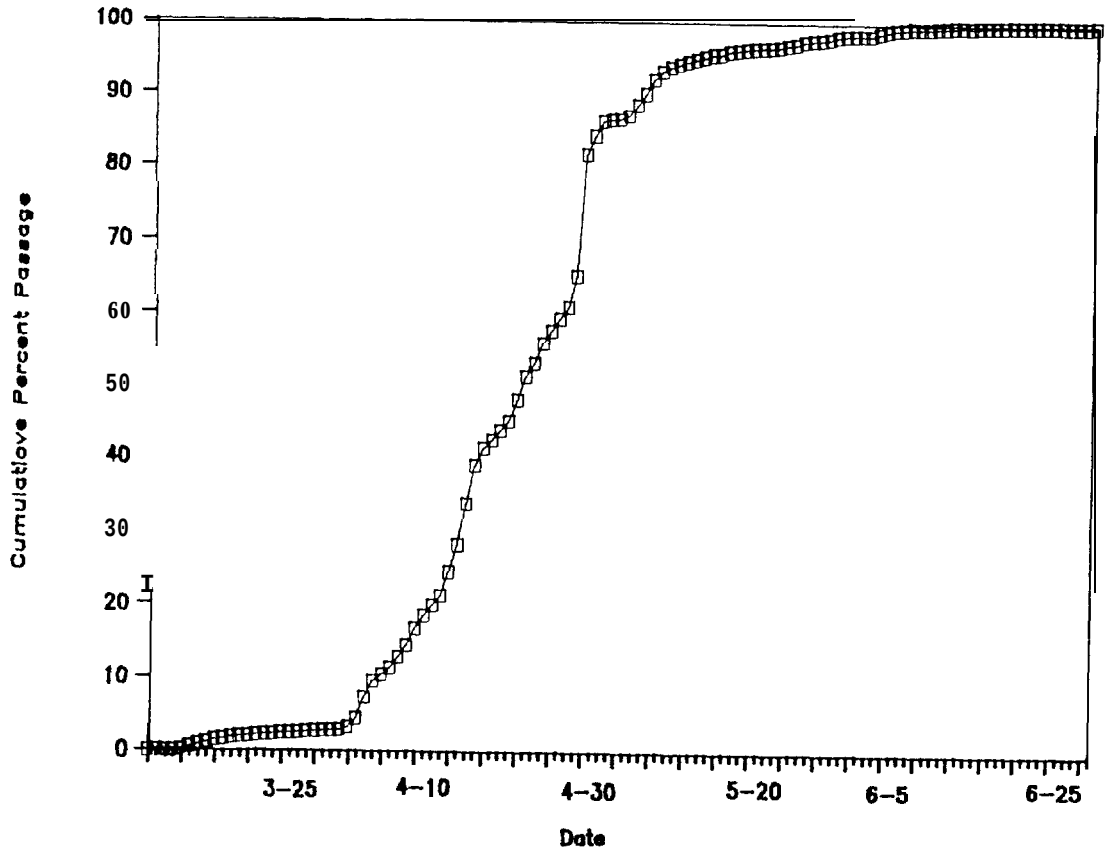

Figure 2. Cumulative *percent* passage of wild spring chinook smolts at Prosser March 9 through June 30, 1987.

Mean fork length of wild spring chinook in the months April through June was 130 mm, 123 mm and 123 mm respectively (Table 7). Mean monthly condition factors for the same time period ranged from 10.8 to 11.5.

The estimated number of branded, wild spring chinook release at Wapatox (released 11/8/86 - 12/3/86) and later captured at Prosser was 2,485 for the period March 1 through July 31. This represented 12.5% of the total number released. With the winter fish figured in, the overall estimated survival rate was 21.2%. The percent of wapatox branded fish migrating to Prosser in the winter compared to the spring was 41.1% and 58.9% respectively.

6.1.3.4 Distinguishing Spring from Fall Chinook

Length frequencies and scale analyses were used to differentiate spring and fall chinook outmigrants. Monthly length frequencies of wild chinook sampled in 1987 are depicted in Figures 3 and 4. Lengths are bimodally distributed in April and May, with fall chinook comprising the first mode and spring chinook the second mode. Fall chinook comprised most the smolt outmigration in June and July (Figure 4).

Explicitly, the number of wild fall chinook migrating past Prosser Dam in a given week was estimated as follows:

$$N_j \sum_{i=a}^{i=b} (L_{i,j})\,(F_{i,j}) = N_{f,j} \qquad \text{equation 1.}$$

where a and b are length increment bounds, with "a" representing "less that 40 mm,", "b" representing

"greater than 199 mm", and with intervening steps of mm—(40-44,45-49,...,195-199);

$L_{i,j}$ = the percent of sampled wild chinook in week j falling in length interval i ;

$F_{i,j}$ = the percent of fish in length interval i in week j determined from scale analysis to be fall chinook, from scale analysis to be fall chinook, i.e., 0-age;

N_j = the estimated outmigration of all wild chinook in week j ; and

$N_{f,j}$ = the estimated number of wild fall chinook in week j.

Table 7. Monthly mean lengths, weights and condition factors for wild spring and fall chinook captured January through June in 1983, 1984 1985, 1986 and 1987 at Prosser smolt trap.

Year	January fork length (mm)	January weight (gm)	January condition factor[a]	February fork length (mm)	February weight (gm)	February condition factor[a]	March fork length (mm)	March weight (gm)	March condition factor[a]	April fork length (mm)	April weight (gm)	April condition factor[a]	May fork length (mm)	May weight (gm)	May condition factor[a]	June fork length (mm)	June weight (gm)	June condition
								Spring chinook										
I.987	114	16.0	10.4	120	18.5	10.4	nd	nd	nd	130	26.8	10.9	123	20.6	10.8	123	21.5	11.5
1986	111	nd	nd	115	15.8	10.7	135	33.0	12.3	129	22.8	10.6	126	22.2	10.6	127	23.0	10.8
1985	122[a]	nd	nd	122[b]	nd	nd	156	44.1	11.0	139	30.1	10.7	126	22.0	10.2	134	333	10.7
1984	nd	nd	nd	nd	nd	nd	134	26.3	108	133	25.8	10.8	135	25.9	103	140	32.4	10.7
1983	nd	nd	nd	nd	nd	nd	-c	-c	-c	129	245	11.1	126	24.2	Il.0	127	nd	nd
								Fall chinook										
1987	-e	-e	-e	-e	-e	-e	-e	-e	-e	89	7.8	11.1	79	5.6	11.3	89	8.4	
1986	4	-e	-e	-e	-e	-e	-e	-e	-e	79	6.5	10.8	99	ll.4	11.5	90	9.0	12.6
1985	-e	-e	-e	4	-e	-e	-e	-e	a	-f	5.6	-f	90	8.6	10.8	86	9.0	11.4
1984	-e	-e	-e	-e	-e	-e	-e	-e	-e		-f		94	10.7	12.2	99	12.6	11.7
1983	-e	-e	-e	-e	4	4	-e	-e	a	88	9.2	12.3	89	9.0	12.3	90	105	13.5

nd= No data available.
[a]Estimated as (W/L 3) x 1,000,000 where w = weight in grams and L = fork length in millimeters.
[b]Anonymous, 1985. January and February data were combined.
[c]Chandler Canal smolt trap not opertated in March 1983.
[d]All wild chinook captured in July classed as fall chinook.
[e]All wild chinook captured before April classed as spring chinook.
[f]No fall chinook were captured in April 1984.

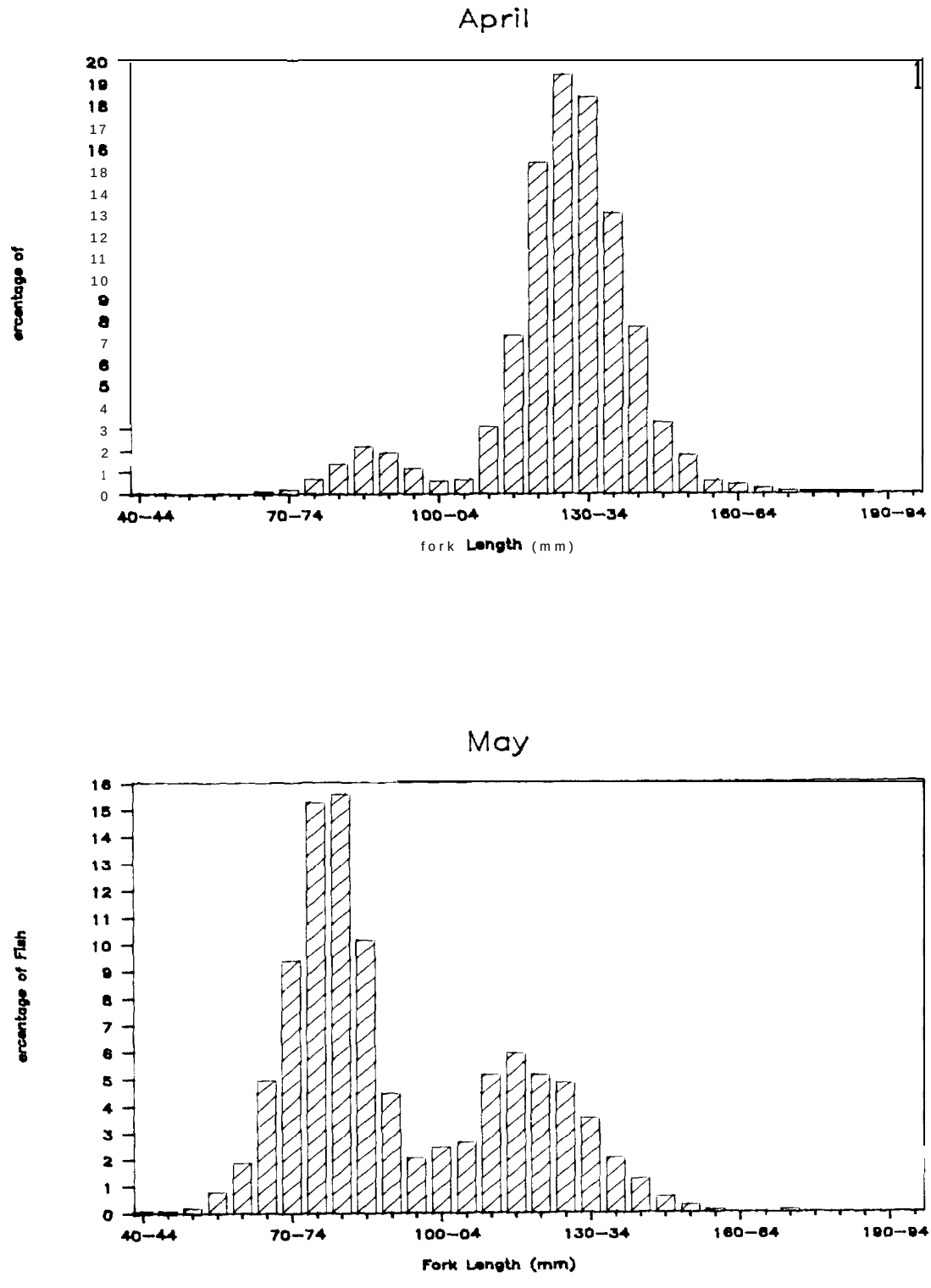

Figure 3. Length frequency distribution for wild spring chinook caught at Prosser smolt trap in April and May 1987.

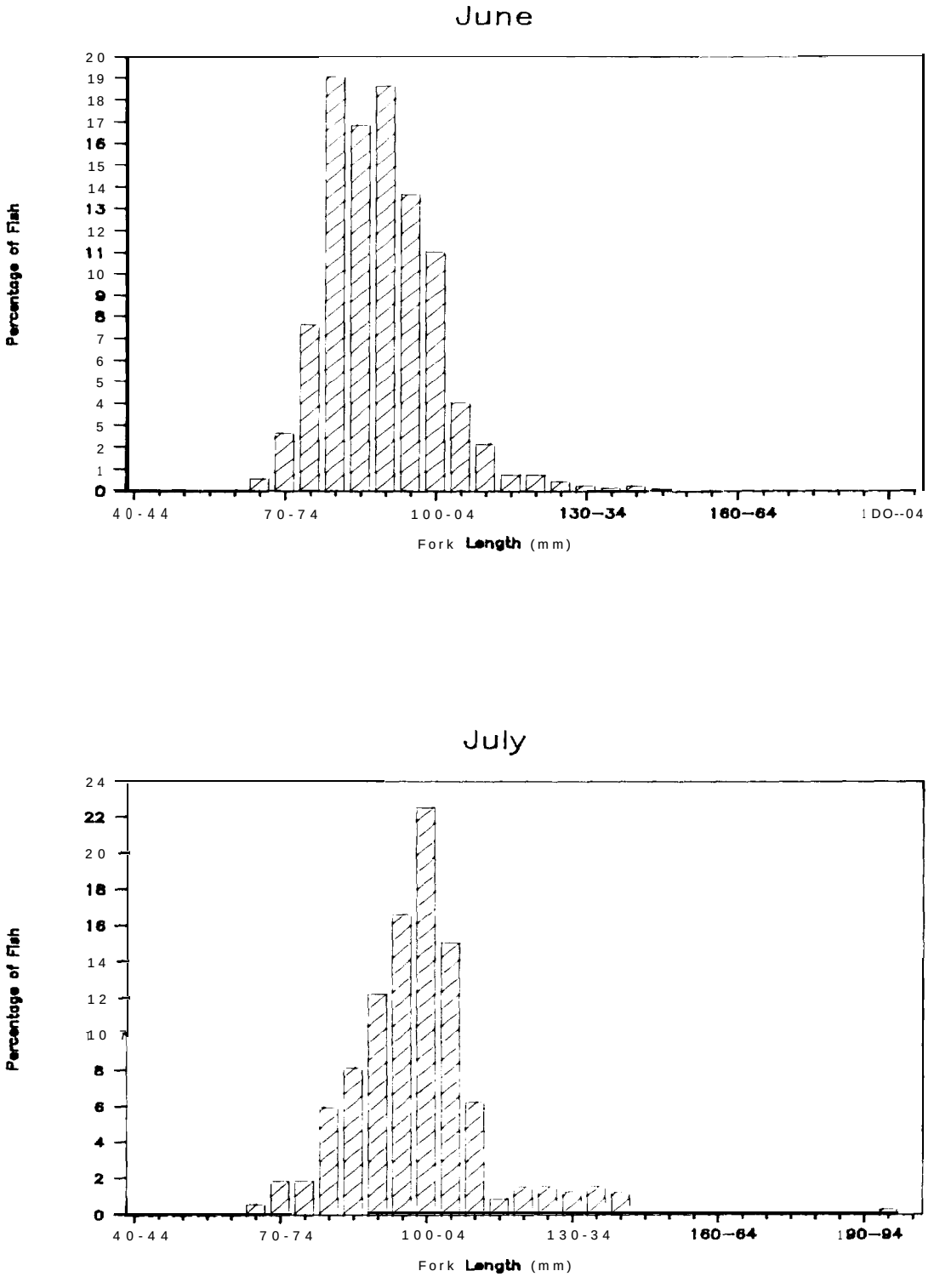

Figure 4. Length frequency distribution for wild spring chinook caught at Prosser smolt trap in June and July 1987.

6.1.3.5 Hatchery Releases

In 1986, survival to Prosser was monitored both by counting freeze-brands (ten percent of total were marked) and by reading coded wire tags extracted from sacrificed fish. A total of 178 coded wire tags were taken from unbranded, ad-clipped hatchery chinook in 1986; results are presented in Table 8.

A Chi-Square test of homogeneity was performed between the recoveries of CWT tagged fish to freeze branded fish, for the various release groups. The Chi-Square statistic was rejected, indicating that between the various release groups, for CWT tagged and freeze branded fish, recoveries were not porportional. The Chi-Square statistic for the 1986 data was 146 (chi-square critical, =.05 was 12.6). It was determined that a large portion of the Chi-Square statistic was generated from the September-85 release group and the chi-Square analysis was recalculated excluding this group. The new Chi-Square statistic was 19 (Chi-Square critical, =.05 was 11.1). Homogeneity was still rejected, however most of the lack of homogeneity is explained by the September-85 release group. This is depicted in Table 8 where the ratio between CWT tagged smolts and freeze branded smolts, for the September-85 group, for percent recovered was 5.0, while the remaining groups were much closer to 1.0.

Table 8. Percent recovery at Prosser smolt trap for each release group, comparing CWT tagged smolts to freeze branded smolts in 1986.

	Test release groups						
	June85	Sept.85	Nov.85	WxW86	WxH86	HxH86	Trucked86
CWT	0.8	9.6	17.6	15.4	18.2	21.7	16.4
F.brand	0.6	1.9	20.1	17.2	23.1	24.7	12.4
CWT/F.B. Ratio	1.3	5.0	0.9	0.9	0.8	0.9	1.3

6.1.3.6. Effect of Acclimation and Volitional Release on Survival.

Mary's pond on the Yakima River (RM 192) was used to acclimate the 1987 smolt releases. The same 12 sites on the upper Yakima (median release point RM 181) used since 1983 were the release sites for non-acclimated fish. Three groups of spring chinook were acclimated in 1987: Leavenworth National Fish Hatchery (LNFH) smolts, "hybrid" smolts (progency of LNFH females and native Yakima males) and hatchery-reared native smolts. Only LNFH hatchery smolts were used in the non-acclimated group.

Acclimated groups were moved to Mary's pond over the period March 19 through March 23. Fish were allowed to volitionally move out of the pond April 13. This was also the same day the trucked smolts were released into the river. However it should be noted that smolts were counted at Prosser as early as April 8, indicating that fish were escaping from the pond prior to formal removal of the block-net at the pond outlet.

A total of 50,113 non-acclimated hatchery spring chinook, of which 5,040 were branded, were released in 1987. Release figures for acclimated hatchery smolts, hybrid smolts and native smolts were 50,519 (5,040 branded), 56,841 (5,240 branded) and 52,392 (5,640 branded). Based on recoveries of branded fish at Prosser, percent survival for non-acclimated hatchery fish was 38.5 and the relative percent survival for acclimated hatchery, hybrid and native smolts was 3.7, 2.8 and 10.6 respectively (Table 9).

A number of problems occurred which made it impossible to obtain an exact count of the smolts that migrated from the acclimation pond in 1987. An unknown number of fish were consumed by an otter that was observed in the pond one week after the smolts were planted (it was removed shortly thereafter). In addition, the water level in the pond dropped below the outlet elevation during the outmigration period due to the river flow being so low that insufficient groundwater seepage occurred to maintain a normal water level. This event prevented an undetermined number of fish from emigrating. Also, a malfunction of the electronic counter placed at the pond outlet precluded obtaining an accurate count on the number of smolt that outmigrated from the pond. Figure 6 presents the cumulative percent outmigration for the four groups. The earliest date of median passage for any of the four groups was April 25, for the acclimated hatchery group. Its mean migration rate to Prosser was 10.3 RM/day. Dates of median passage for the remaining three groups; non-acclimated hatchery, acclimated hybrid, and native were April 27, April 30 and May 2, and mean migration rates were

10.3 RM/day, 8.5 RM/day and 7.6 RM/day respectively. Despite having the slowest migration rate, the acclimated native smolts had the highest survival rate.

Table 9. Revised outmigration and survival estimates for acclimated and non-acclimated hatchery chinook smolts for 1983 through 1987, and for hybrid and native chinook smolts in 1986 and 1987.

Year	Release group	Number of branded fish release	Estimated number of branded fish migrating to Prosser	Percent survival
1987	Truck	5,040	1,940	38.8
	Pond	5,040	185	3.7[a]
	Hybrid	5,240	146	2.8[a]
	Native	5,640	601	10.6[a]
1986	Truck	6,383	508	8.0
	Pond	5,910	987	16.7
	Hybrid	5,438	959	17.6
	Native	5,255	993	18.9
1985	Truck	3,841	899	23.4
	Pond	6,056	1,236	20.4
1984	Truck	6,818	2,380	34.9
	Pond	4,653	2,703	58.1
1983	Truck	8,225	1,699	20.6
	Pond	9,905	3,815	38.5

[a]Survival rates are relative.

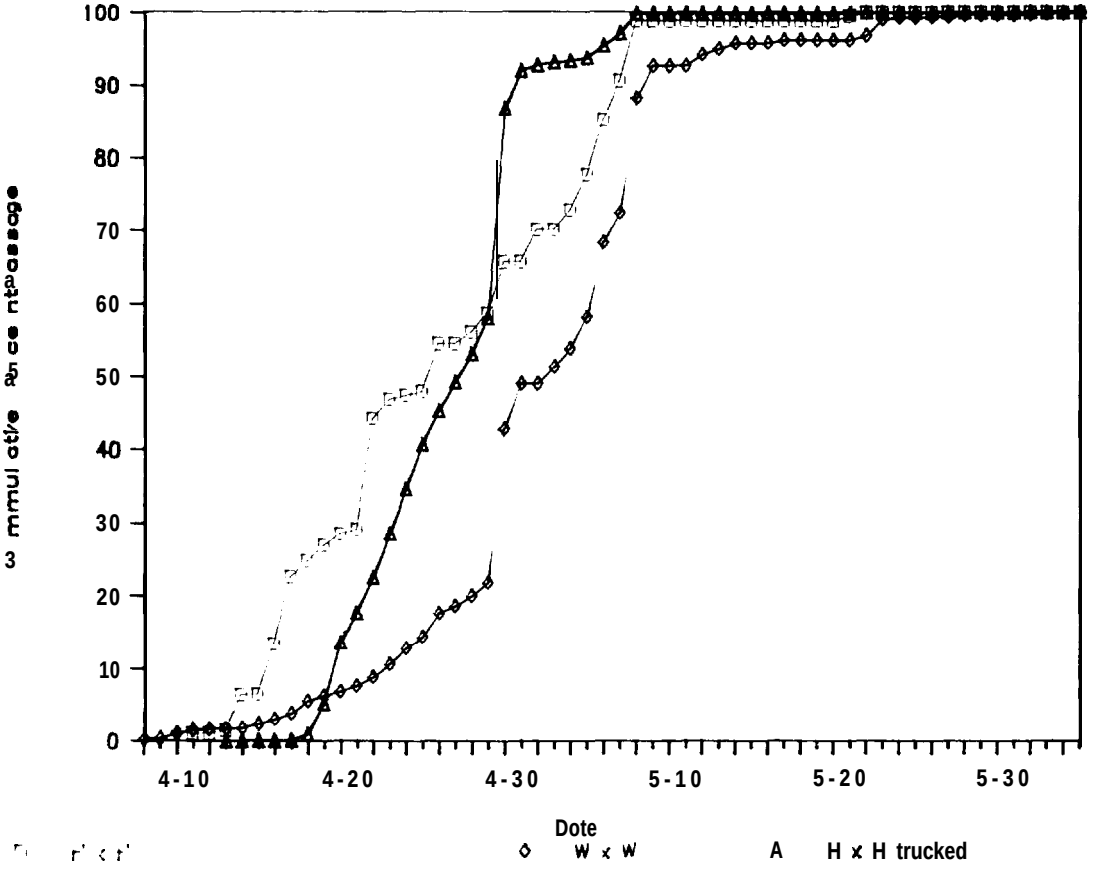

Figure 5. Cumulative percent passage of trucked hatchery and acclimated hatchery, hybrid and wild spring chinook smolts past Prosser Dam in 1987.

6.1.4 WAPATOX SMOLT TRAP

Wapatox smolt trap operated until December 2, 1986 when the screens were removed from Wapato Diversion Canal due to icing conditions. A monthly summary of the estimated number of spring chinook outmigrants in the fall of 1986 is presented in Table 10. The estimated passage of spring chinook pre-smolts in October and November were 8,707 and 48,779 respectively. The highest period of outmigration occurred November 18 through December 1 when 45,155 pre-smolts were estimated to have passed Wapatox. High stream discharge may account for this. Stream discharge increased from a mean of 438 cfs for the five preceeding weeks, to a mean of 1,236 cfs during this time period.

The October and November size distributions are presented in Figure 6. Mean monthly fork lengths in October and November were 94 and 95 mm, respectively.

Monitoring of the smolt outmigration began April 1 when the screens were installed into the Wapato Diversion Canal. A monthly summary of the estimated number of spring chinook outmigrants in 1987 is presented in Table 10. Estimated spring chinook smolt outmigration in April, May and June was 13,561, 2,335 and 245 respectively. Total estimated outmigration past Wapatox was 16,141 smolts. Estimated pre-smolt outmigration in July, August and September was 608, 1,158 and 3,464 respectively.

The estimated weekly catch of spring chinook is presented in Table 11. The week of highest estimated outmigration was during the first week of operation April 1-7, when 4,123 smolts

outmigrated. This represented 27% of the total estimated outmigration. Median passage date was April 18.

Monthly size distributions of spring chinook smolts are presented in Figures 7, 8 and 9. Mean monthly fork lengths in April, May and June were 94, 97 and 107 mm, respectively. Mean lengths of pre-smolts in July, August and September were 79, 82 and 87 mm, respectively.

Table 10. Summary of monthly outmigration of spring chinook at Wapatox in 1985, 1986 and 1987.

Year	Species	April	May	June	July	August	September	October	November
1985	Spring chinook	38,786	2,823	323	193	140	4,941	39,271	15,573[a]
1986	Spring chinook	2,925	3,902	765	509	169	2,178	8,707	48,779
1987	Spring chinook	13,561	2,335	245	608	1,158	3,464	b	b

[a]Trap was only operated 11/1 to 11/10.
[b]Data not available at time of writing.

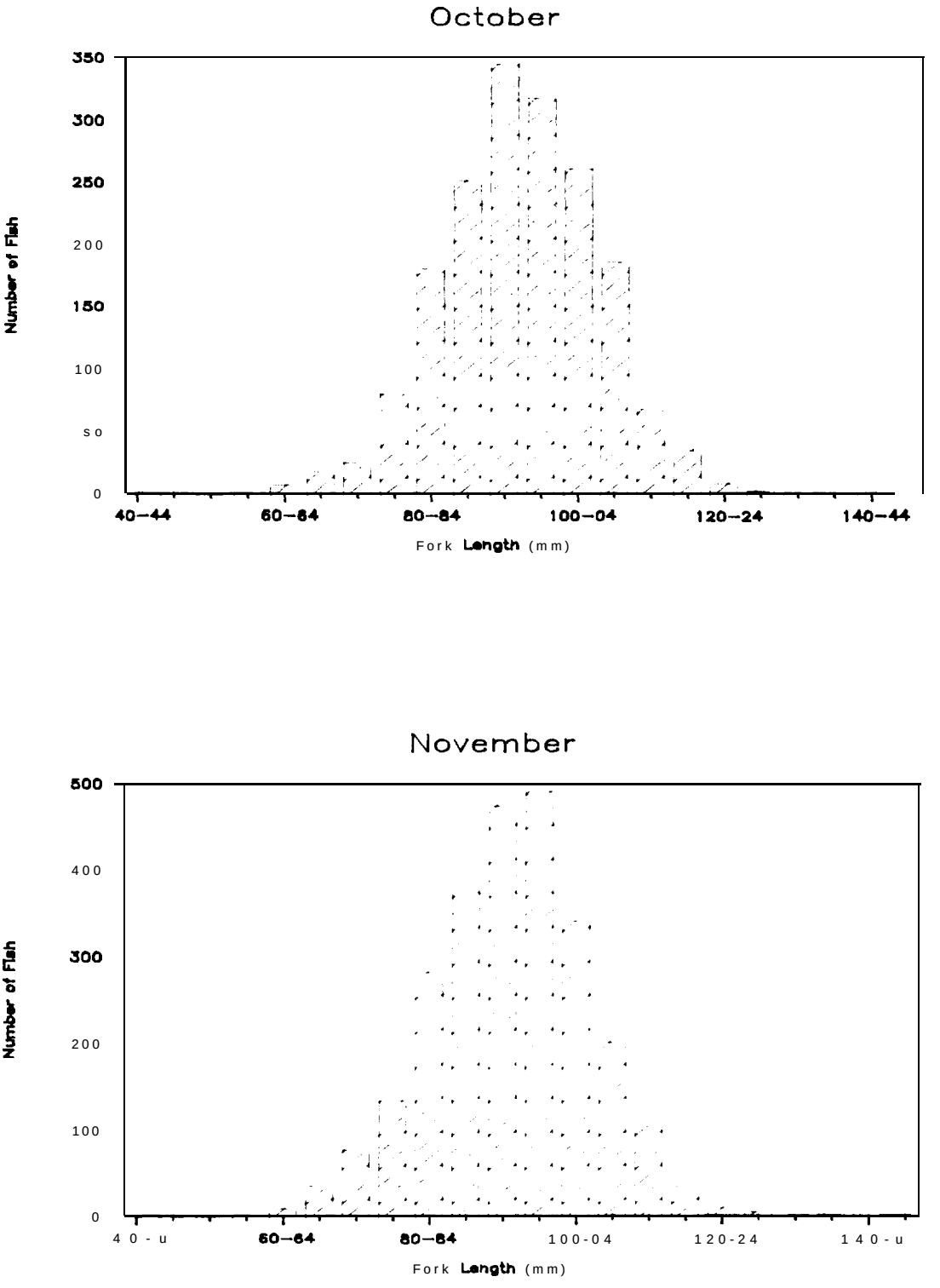

Figure 6. Monthly size distribution of spring chinook at Wapatox in October and November 1986.

Table 11. Estimated weekly catches of spring chinook at Wapatox, fall, 1986 and 1987.

Fall, 1986		Spring and summer, 1987			
Date	Chinook pre-smolt	Date	Chinook smolt	Chinook pre-smolt	Cumulative percent smolt passage
9/30-10/6	357	4/1-7	4,359	—	27.0
10/7-13	1,611	4/8-14	2,012	—	39.0
10/14-20	1,651	4/15-21	4,123	—	65.0
10/21-27	1,980	4/22-28	4,123	—	79.0
10/28-11/3	3,930	4/29-5/5[a]	2,055	—	92.0
11/4-10	1,856	5/6-12[a]	435	—	95.0
11/11-17	1,609	5/13-19[a]	271	—	96.0
11/18-24	23,247	5/20-26	246	—	98.0
11/25-12/1	21,868	5/27-6/2	104	—	98.6
		6/3-9	54	—	99.0
		6/10-16	66	—	99.4
		6/17-23	73	—	99.8
		6/24-30	30	—	100.0
		7/1-7		59	
		7/8-14		68	
		7/15-21		182	
		7/22-28		120	
		7/29-8/4		448	
		8/5-11		103	
		8/12-18		243	
		8/19-25		359	
		8/26-9/1		212	
		9/2-8		107	
		9/9-15		523	
		9/16-22		573	
		9/23-29		1,703	
Totals	58,109		16,141	4,700	

[a]Trap was inoperable a portion of this week due to high river discharge. interpolation was used to estimate daily catches on these days.

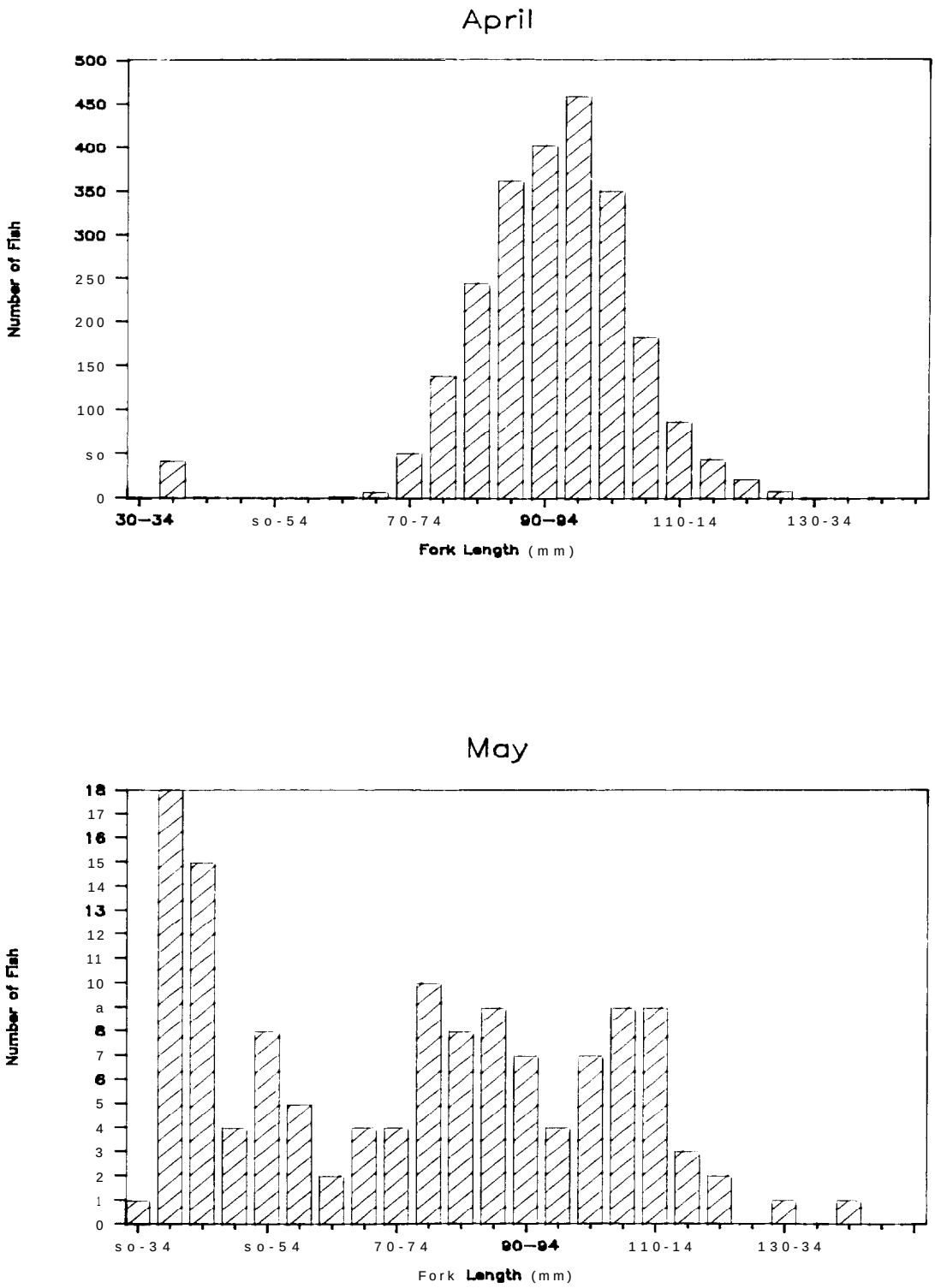

Figure 7. Monthly size distribution of spring chinook at Wapatox in April and May 1987.

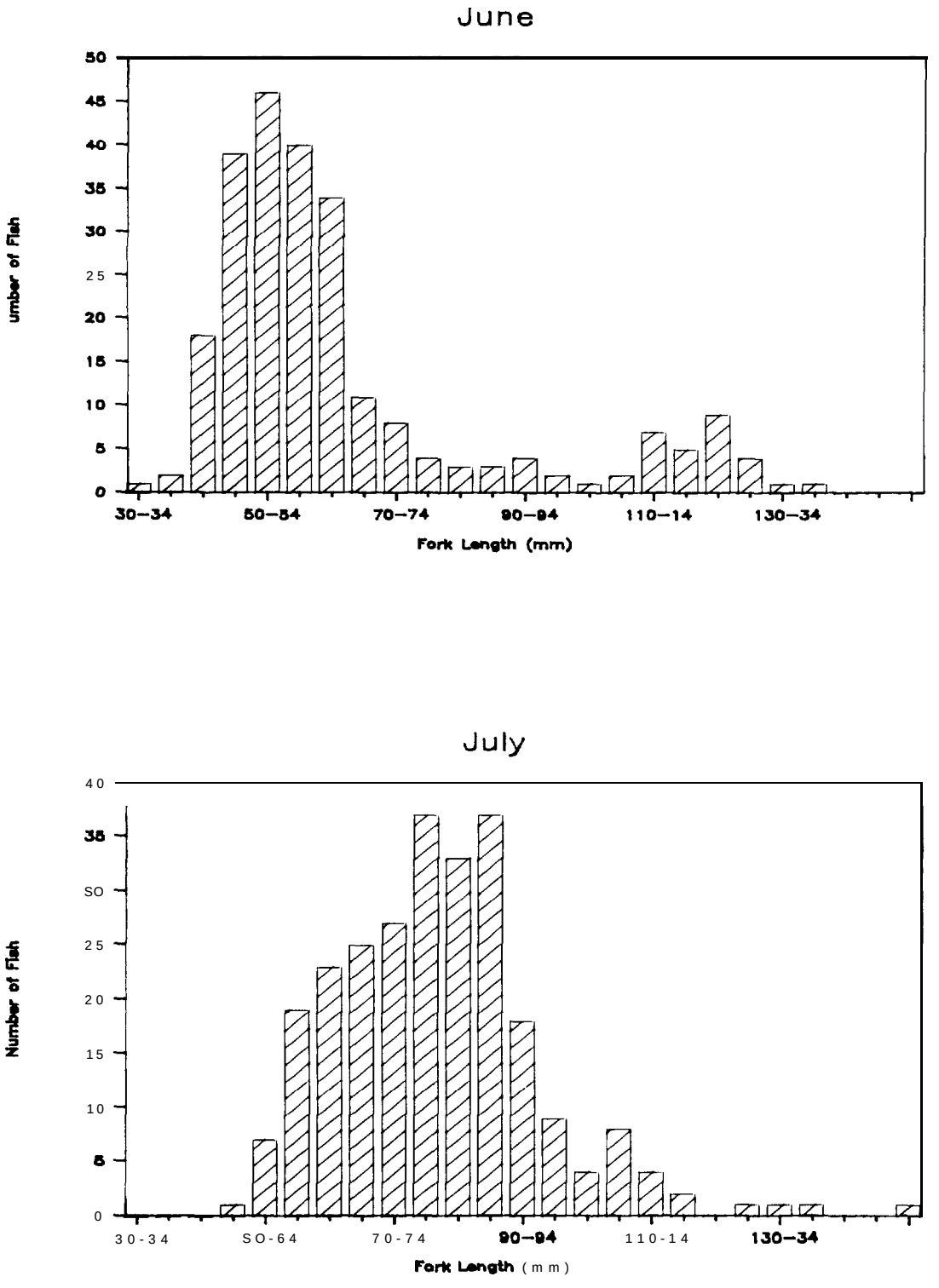

Figure 8. Monthly size distribution of spring chinook at Wapatox June and July 1987.

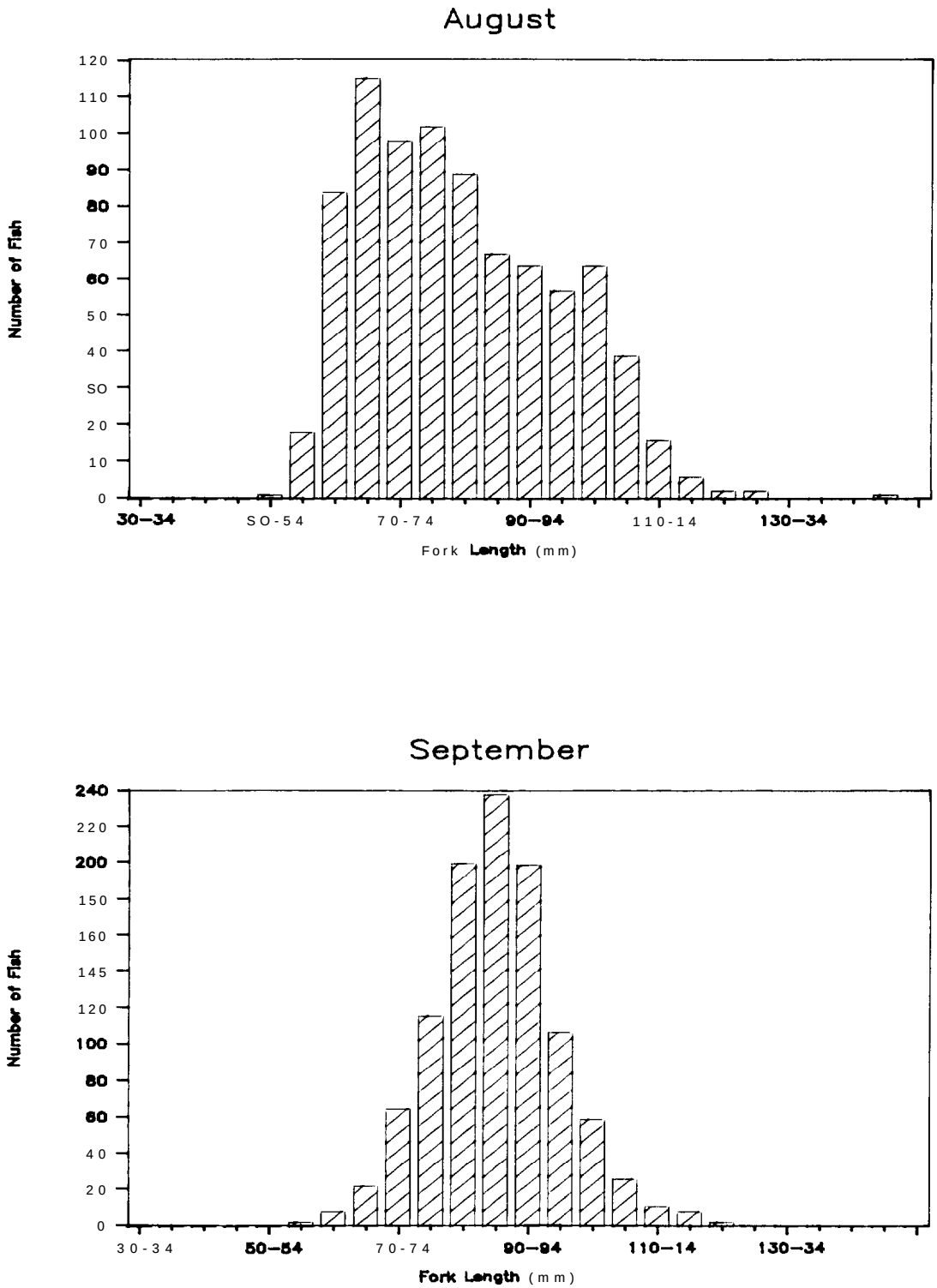

Figure 9. Monthly size distritbution of spring chinook at Wapatox in August and September.

6.1.5 ADULT RETURNS

In 1987 a total of 3,683 adult and 335 jack spring chinook salmon returning to the Yakima River were counted at Prosser fish ladder at RM 48 (Tables 12 and 13). This gives a total of 4,018 salmon returning to Prosser Dam (Table 15). The raw daily fish counts for Prosser Dam are presented in Appendix Tables A.1 through A.4. The mean dates of passage were May 12 and May 16 for adults and jacks respectively. An additional 372 fish were estimated to have been caught in the Yakima River subsistence dipnet fishery below Horn Rapids and Prosser Dams (Table 15). Therefore, total return to the Yakima system was 4,390 spring chinook salmon (Table 16).

Spring chinook were counted at Roza Dam from May 1 to September 30, 1987. Passage at Roza Dam was 1,610 adult and 67 jack spring chinook for a total of 1,677 wild fish (Tables 18, 19, and 20). A total of 245 adult and 9 jack hatchery spring chinook were collected at Roza Dam to recover the coded wired tags for release group identification. An additional 174 fish were harvested between Prosser and Roza Dams in the subsistence dipnet fishery (Table 15). Daily raw counts of fish passage at Roza Dam are presented in Appendix Tables A.5 through A.9. The median dates of passage at Roza Dam were May 29 and May 26 for spring chinook adults and jacks respectively.

A summary of adult and jack returns to each of the dams, harvest below and above Prosser, and the number of fish available to spawn in the Yakima and Naches Rivers is presented in Table 20.

Table 12. Weekly adult spring chinook passage at Prosser Dam, 1987. (1) Index week number; (2) Week-ending date; (3) Weekly passage; (4) Weekly proportion; (5) Cumulative passage; (6) Cumulative proportion

(1)	(2)	(3)	(4)	(5)	(6)
12	325	2	0.0005	2	0.0005
13	401	0	0.0000	2	0.0005
14	408	0	0.0000	2	0.0005
15	415	11	0.0030	13	0.0035
16	422	99	0.0269	112	0.0304
17	429	356	0.0967	468	0.1271
18	506	637	0.1730	1105	0.3000
19	513	1125	0.3055	2230	0.6055
20	520	741	0.2012	2971	0.8067
21	527	377	0.1024	3348	0.9090
22	603	155	0.0421	3503	0.9511
23	610	104	0.0282	3607	0.9704
24	617	19	0.0052	3626	0.9845
25	624	34	0.0092	3660	0.9938
26	701	8	0.0022	3668	0.9959
27	708	8	0.0022	3676	0.9981
28	715	5	0.0014	3681	0.9995
29	722	0	0.0000	3681	0.9995
30	729	2	0.0005	3683	1.0000

Mean date: May 12

Table 13. Weekly jack spring chinook passage at Prosser Dam, 1987. (1) Index week number; (2) Week-ending date; (3) Weekly passage; (4) Weekly proportion; (5) Cumulative passage; (6) Cumulative proportion

(1)	(2)	(3)	(4)	(5)	(6)
17	429	6	0.0179	6	0.0179
18	506	100	0.2985	106	0.3164
19	513	48	0.1433	154	0.4597
20	520	79	0.2358	233	0.6955
21	527	54	0.1612	287	0.8567
22	603	24	0.0716	311	0.9284
23	610	11	0.0328	322	0.9612
24	617	4	0.0119	326	0.9731
25	624	3	0.0090	329	0.9821
26	701	1	0.0030	330	0.9851
27	708	1	0.0030	331	0.9881
28	715	4	0.0119	335	1.0000

Mean date: May 16

Table 14. Weekly total spring chinook passage at Prosser Dam, 1987 .
(1) Index week number; (2) Week-ending date; (3) Weekly passage; (4) Weekly proportion; (5) Cumulative passage; (6) Cumulative proportion

(1)	(2)	(3)	(4)	(5)	(6)
12	325	2	0.0005	2	0.0005
13	401	0	0.0000	2	0.0005
14	408	0	0.0000	2	0.0005
15	415	11	0.0027	13	0.0032
16	422	99	0.0246	112	0.0279
17	429	362	0.0901	474	0.1180
18	506	737	0.1834	1211	0.3014
19	513	1173	0.2919	2384	0.5933
20	520	820	0.2041	3204	0.7974
21	527	431	0.1073	3635	0.9047
22	603	179	0.0445	3814	0.9492
23	610	115	0.0286	3929	0.9778
24	617	23	0.0057	3952	0.9836
25	624	37	0.0092	3989	0.9928
26	701	9	0.0022	3998	0.9950
27	708	9	0.0022	4007	0.9973
28	715	9	0.0022	4016	0.9995
29	722	0	0.0000	4016	0.9995
30	729	2	0.0005	4018	1.0000

Mean date: May 12

Table 15. YIN Yakima River spring chinook fishery, 1981 - 1987.

	Estimated chinook	Horn Rapids harvests		Prosser harvests		Sunnyside harvests		Wapato harvests		Total harvests	
Year	run size	CH	SH	CH	SH	CH	SH	CH	SH	CH	SH
1981	1,334	0	0	49	2	137	1	30	0	216	3
1982	1,686	10	0	78	0	241	11	105	2	434	13
1983	1,324	0	0	72	1	9	11	3	0	84	16
1984	2,677	3	0	116	4	122		18 48	3	289	25
1985	4,529	54	0	267	3	61	0	483	21	865	24
1986	9,442	158	3	372	2	212	0	598	0	1,340	5
1987	4,390	40	0	332	0	60	0	114	6	546	6
81-87 Average	3,626	38	0	184	2	120	6	197	5	546	6

Table 16. Estimated spring chinook runs to the Yakima River basin, 1957-1987.

Year	Total redds[a] Naches	Yakima	Total	Escapement[b]	Harvest[c]	Total run
1957	764	1216	1980	4752	7913	12665
1958	284	531	815	1956	4401	6357
1959	306	255	561	1346	3464	4810
1960	126	184	310	744	3668	4412
1961	166	175	341	818	5044	5862
1962	153	76	229	550	4185	4735
1963	185	—	—	—	2992	—
1964	50	81	131	314	3241	3555
1965	53	90	143	343	1763	2106
1966	95	32	127	305	4800	5105
1967	58	97	155	388	3195	3583
1968	25	61	86	206	2430	2636
1969	50	309	359	862	618	1480
1970	48	23	71	170	1512	1682
1971	—	97	—	—	1232	—
1972	55	101	156	374	480	854
1973	28	41	69	166	3221	3387
1974	30	40	70	168	1748	1916
1975	—	104	—	—	600	—
1976	35	108	143	343	—	—
1977	10	121	131	314	—	—
1978	95	308	403	967	—	—
1979	153	86	239	574	—	—
1980	113	353	466	1118	106	1224
1981	172	294	466	1118	216	1334
1982	54	573	626	1252	434	1686
1983	83	360	443	1240	84	1324
1984	220	634	854	2050	289	2677[d]
1985	427	951	1378	3582	865	4527[d]
1986	1298	1780	3078	7387	1300	8687
1987	675	956	1631	3294	546	4390

[a] Redd counts for 1957-1961 are total redd counts from Major and Mighell (1969). For 1962-1980 the counts are index counts from WDF or YIN coordinated surveys. Index counts in this time period were expanded by 1.8 and 2.5 for the upper Yakima and Naches systems, respectively. (Expansion factors were derived from the ratio of index counts to total counts for the respective systems. Total counts were from the Major and Mighell study and from the 1981-1987 surveys.) For 1981-1987 the counts are total redd counts from USBWS, YIN, and WDF cooperative surveys.

[b] Based on Roza Dam counts the number of fish per redd has overaged 2.4 in the upper Yakima since 1982. Historical escapement for 1958 to 1981 was therefore estimated as the total redd count multiplied by 2.4. For 1982 to 1987 the actual number of fish per redd was used to expand the total redd count.

[c] 1957-1975 WDF tribal harvest estimates; 1980-1987 YIN tribal harvest estimates. All harvest estimates are for the Yakima River only.

[d] Total run estimates since 1984 are the sum of the Prosser Dam counts and the estimated harvests below Prosser Dam.

Table 17. Weekly adult spring chinook passage at Roza Dam, 1987. (1) Index week number; (2) Week-ending date; (3) Weekly passage; (4) Weekly proportion; (5) Cumulative passage; (6) Cumulative proportion

(1)	(2)	3)	(4)	(5)	(6)
18	506	2	0.0012	2	0.0012
19	513	52	0.0323	54	0.0335
20	520	208	0.1292	262	0.1627
21	527	517	0.3211	779	0.4839
22	603	230	0.1429	1009	0.6267
23	610	164	0.1019	1173	0.7286
24	617	97	0.0602	1270	0.7888
25	624	61	0.0379	1331	0.8267
26	701	81	0.0503	1412	0.8770
27	708	35	0.0217	1447	0.8988
28	715	20	0.0124	1467	0.9112
29	722	37	0.0230	1504	0.9342
30	729	19	0.0118	1523	0.9460
31	805	13	0.0081	1536	0.9540
32	812	14	0.0087	1550	0.9627
33	819	17	0.0106	1567	0.9733
34	826	10	0.0062	1577	0.9795
35	902	14	0.0087	1591	0.9882
36	909	13	0.0081	1604	0.9963
37	916	5	0.0031	1609	0.9994
38	923	0	0.0000	1609	0.9994
39	930	1	0.0000	1610	1.0000

Mean date: May 29

Table 18. Weekly jack spring chinook passage at Roza Dam, 1987. (1) Index week number; (2) Week-ending date; (3) Weekly passage; (4) Weekly proportion; (5) Cumulative passage; (6) Cumulative proportion

(1)	(2)	(3)	(4)	(5)	(6)
20	520	5	0.0746	5	0.0746
21	527	30	0.4478	35	0.5224
22	603	13	0.1940	48	0.7164
23	610	6	0.0896	54	0.8060
24	617	6	0.0896	60	0.8955
25	624	1	0.0149	61	0.9104
26	701	1	0.0149	62	0.9254
27	708	0	0.0000	62	0.9254
28	715	1	0.0149	63	0.9403
29	722	0	0.0000	63	0.9403
30	729	1	0.0149	64	0.9552
31	805	0	0.0000	64	0.9552
32	812	0	0.0149	65	0.9701
33	819	1	0.0000	65	0.9701
34	826	2	0.0299	67	1.0000

Mean date: May 26

Table 19. Weekly total spring chinook passage at Roza Dam, 1987 (1) Index week number; (2) Week-ending date; (3) Weekly passage;) (4) Weekly proportion; (5) Cumulative passage; (6) Cumulative proportion

(1)	(2)	(3)	(4)	(5)	(6)
18	506	2	0.0012	2	0.0012
19	513	52	0.0310	54	0.0322
20	520	213	0.1270	267	0.1592
21	527	547	0.3262	814	0.4854
22	603	243	0.1449	1057	0.6303
23	610	170	0.1014	1227	0.7317
24	617	103	0.0614	1330	0.7931
25	624	62	0.0370	1392	0.8301
26	701	82	0.0489	1474	0.8790
27	708	35	0.0209	1509	0.8998
28	715	21	0.0125	1530	0.9123
29	722	37	0.0221	1567	0.9344
30	729	20	0.0119	1587	0.9463
31	805	13	0.0078	1600	0.9541
32	812	15	0.0089	1615	0.9630
33	819	17	0.0101	1632	0.9732
34	826	12	0.0072	1644	0.9803
35	902	14	0.0083	1658	0.9887
36	909	13	0.0078	1671	0.9964
37	916	5	0.0030	1676	0.9994
38	923	0	0.0000	1676	0.9994
39	930	1	0.0006	1677	1.0000

Mean date: May 29

Table 20. Total spring chinook salmon return to the Yakima River and to the spawning grounds in 1987.

Return to Prosser	
Adults to Prosser Dam	3,683
Jacks to Prosser Dam	335
Total M to Prosser	4,018
Harvest below Prosser	372
Total run to the river	4,390
Return to Roza	
Adults to Roza Dam	1,610
Jacks to Roza Dam	67
Total Run to Roza available to spawn in upper Yakima	1,677
Harvest between Prosser and Roza	174
Fish spawning between Roza and Prosser[a]	253
Number of fish available to spawn in the Naches River[b]	1,914

[a] It was calculated that there are 2.02 fish per redd in the Yakima giving a total of 253 fish spawning below Roza Dam in the Yakima River.
[b] Calculated as number of fish counted at Prosser, minus the harvest between Prosser and Roza minus the fish spawning in the Yakima below Roza minus the number of fish counted at Roza ladder.

The spring chinook redd counts from 1981 to 1987 are presented in Table 21. These counts were not part of the data collected on the present spring chinook study but are important for estimates of survival through various life stages and are included in this report for that reason.

Upper Yakima Surveys: A total of 1,063 redds were reported from surveys on the upper Yakima. A total of 923 were above Roza Dam and an additional 140 were discovered in the area between Roza Dam and Selah Bridge.

The number of chinook escaping past Roza was 1,677; the number of redds was 923. The resulting statistic was 1.82 fish per redd. There is no accounting for pre-spawning mortality by this method. Consequently, 1.82 does not necessarily reflect the average number of fish observed on a redd on the spawning grounds.

Naches Surveys: There were a total of 677 redds found on the Naches River in 1987. This represents a decline in the redds counted on the Naches system from 1986. Substantial increases were observed in nearly all established spawning areas over the 1985 spawning season when the spring chinook escpapment was similar to this years escapement.

Table 21. Yakima River Basin spring chinook redd counts, 1981 - 1987.

	1981	1982	1983	1984	1985	1986	1987
Upper Yakima system							
Easton	126	204	104	302	322	352	278
Game Ramp							45
Freeway Bridge	30	159	87	145	137	352	211
S. Cle Elum Bridge	39	80	77	67	118	253	205
Teanaway Reach	2	8[a]	20	9	22[a]	118	70
Ellensburg Town Ditch	5	—	25	11	17		26
Cle Elum River	57	30	15	31	153	77	75
Teanaway River	0	0	0	0	3	0	-
Miscellaneous	—	—	—	3[b]	102	514[c]	153[d]
Subtotal	294	573	360	634	951	1793	1063
Naches system							
American River	72	11	36	72	141	464	222
Bumping River	20	6	11	26	74	196	133
Little Naches River	16	12	9	41	44	110	42
Rattlesnake Creek	0	2	4	24	11	17	28
Naches River	64	23	23	57	157	526	252
Subtotal	172	54	83	220	427	1313	677
Basin total	466	627	443	854	1378	3106	1740

[a]Teanaway River to Thorp Bridge
[b]Manastash Creek (rm 0.0-4.6)
[c]Roza Dam to Selah Bridge - 321 redds; Thorp Bridge to KOA - 110 redds; KOA to Wilson Creek - 64 redds; Wilson Creek to Burbank Creek - 18 redds; and downtown Yakima - 1 redd.
[d]Roza Dam to Selah Bridge - 140 redds; KOA to Roza Dam - 13; Selah to Ahtanum Creek confluence - 0.

6.1.6 ESTIMATES OF SURVIVAL THROUGH VARIOUS LIFE STAGES

6.1.6.1 Egg to Fry:

Survival from egg to fry was discussed extensively in the survival to emergence sections of the 1985 and 1986 annual reports. The survival from egg to emergent fry was calculated to be 59.6% which is the mean of the 62.5% estimate in 1985 and 56.7% in 1986. As discussed earlier the 1987 studies were terminated by high spring runoff and extensive bedload sediment trapped in the redd cap nets.

Total egg deposition in the Yakima system from 1981 to 1987 is presented in Table 23. Total egg deposition was calculated as the sum of three subareas: the upper Yakima, the American River, and the remaining Naches system due to different mean size of females in each of these areas. The mean fecundity as calculated from the length fecundity model and the mean length of females measured in each subarea in 1985 was 3,908 eggs/female in the upper Yakima, 6,198 eggs/female in the American River and 5,150 eggs/female in the rest of the Naches system.

The total number of fry produced from the egg deposition in 1981 to 1987 is reported in Table 23. This estimate is based on the current 59.6% egg to fry survival rate which is the mean of the 62.5% estimate in 1985 and the 56.7% from 1986.

Table 22. Total estimated egg deposition in the Yakima Basin for 1981 to 1987.

Brood year	Subarea	Number of redds	Eggs/redd	Total
1981	American River	72	6,198	446,256
	Naches (other)	100	5,150	515,000
	Yakima (upper)	294	3,908	1,148,952
	Total	466		2,110,208
1982	American	11	6,198	68,178
	Naches	43	5,150	221,450
	Yakima	573	3,908	2,239,284
	Total	628		2,528,912
1983	American	47	5,150	223,128
	Naches	360	3,908	242,050
	Yakima			1,406,880
	Total	443		1,872,058
1984	American	72	6,198	446,256
	Naches	148	5,150	762,200
	Yakima	634	3,908	2,477,672
	Total	854		3,686,128
1985	American	141	6,198	873,918
	Naches	286	5,150	1,472,900
	Yakima	951	3,908	3,716,508
	Total	1,378		6,063,326
1986	American	464	6,198	2,875,872
	Naches	850	5,150	4,377,500
	Yakima	1,796	3,908	7,018,768
	Total	3,110		14,272,140
1987	American	222	6,198	1,375,956
	Naches	455	5,150	2,343,250
	Yakima	1,063	3,908	4,154,204
	Total	1,740		7,873,410

Table 23. Estimated fry production from eggs deposited in the Yakima Basin from 1981 to 1987.

Brood year	Total egg deposition	% survival	Total fry
1981	2,110,208	59.6	1,257,684
1982	2,528,912	59.6	1,507,232
1983	1,872,058	59.6	1,115,747
1984	3,686,128	59.6	2,196,932
1985	5,189,408	59.6	3,092,887
1986	14,272,140	59.6	8,506,195
1987	7,873,410	59.6	4,692,552

6.1.6.2 Egg to Smolt:

The egg to smolt (S_{es}) survival was calculated as the number of smolts estimated to outmigrate past Prosser divided by the total egg deposition for their year class as calculated in Table 23. The egg to smolt survival from egg deposition for the brood years 1981 to 1985 and corresponding smolt outmigration years of 1983 to 1987 are presented in Table 24.

This mean percent survival from egg to smolt of 4.9% is much lower than the 10.7% (range from 5.4 to 16.4) reported by Major and Mighell (1969). Bjornn (1978) evaluated natural production of spring chinook in the Lemhi River, Idaho, and over an 8-year period found that survival from egg to migrant smolt averaged 9.8% (range 4.0% to 15.9%). This is also much higher than the five year mean of 4.9% we found. He considered the level of spawning escapments to the upper Lemhi River

Table 24. Egg to smolt survival for 1981 to 1985 brood years in the Yakima Basin.

Brood year	Egg deposition	Outmigrating smolts	Percent survival
1981	2,110,208	136,102	6.5%
1982	2,528,912	123,732	4.9%
1983	1,872,058	83,614	4.5%
1984	3,686,128	169,077	4.6%
1985	6,063,326	251,975	4.2%
Mean	2,549,327	128,131	4.9%

low during the study years, thus underseeding may have resulted in maximum survival rates for juvenile chinook in that system.

Several other studies conducted on mid-Columbia tributaries had survival rates similar to those observed in the current study. In the Deschutes River, Oregon Johasson and Lindsay (1983) found an average egg-to-migrant survival rate of 3.5 percent (range 2.3% to 5.5%) for their spring chinook smolts. These were primarily yearling spring migrants but also included fall (age 0) migrants. An egg-to-migrant survival rate of 5.2% (range 3.6% to 6.7%) was found for spring chinook in the John Day River, Oregon, (Lindsay et al., 1981). These percentages were based on yearling spring migrants only.

In 1986-1987 were we able to make an estimate of the winter outmigration in the Yakima River because the screens were left in the canal due to the milder than average winter. The winter outmigration increased the total 1987 smolts outmigration from 251,975 to 330,323 smolts. The new Chandler Canal screens will allow winter sampling to occur more regularly in the future.

6.1.6.3 Fry to Smolt:

An estimate of the survival from fry to smolt (S_{fs}) based on the fry production (Table 23) and smolt outmigration at Prosser for the brood years of 1981 to 1985 is reported in Table 25.

Table 25. Estimated survival from fry to smolt in the Yakima Basin for brood years 1981 to 1985.

Brood year	Fry produced	Smolt out-migration	Percent survival
1981	1,257,684	136,102	10.3%
1982	1,507,232	123,732	7.6%
1983	1,115,747	83,614	7.1%
1984	2,196,932	169,077	7.7%
1985	3,613,742	251,975	7.0%
Mean	1,938,267	152,900	7.9%

6.1.6.4 Smolt to Adult:

The smolt to adult (S_{sa}) survival based on the 1983 smolt outmigration estimated at Prosser and the 1984 return of jacks (3 year old fish), the 1985 return of four year old adults, and the 1986 return of five year old adults to the Yakima River is reported in Table 26. It was estimated that 6,012 wild three, four, and five year old fish returned from an estimated smolt outmigration of 135,548 fish in 1983.

The smolt to adult (S_{sa}) based on the 1984 smolt outmigration estimated at Prosser and the 1985 return of jacks and the 1986

return of four year old adults and the 1987 return of five year old adults to the Yakima River is reported in Table 29.

The smolt to adult (S_{sa}) based on the 1985 smolts outmigration estimated at Prosser and the 1986 return of jacks and the 1987 return of four year old adults to the Yakima River is reported in Table 30.

This estimated rate of survival from smolt to adult is also subject to error due to our estimation of total outmigration. We are quite confident in the smolt outmigration estimation procedure for Prosser (Section 6.1.3). However, from the recent findings at Wapatox smolt trap indicating an extensive fall outmigration, and the premliminary findings at Prosser smolt trap this past winter (see section 6.1.3.1), there may be a large outmigration of pre-smolt spring chinook in the months when the Chandler Canal smolt trap is inoperable due to screen removal.

Table 26. Estimation of smolt to adult survival of the 1983 smolt outmigration from the Yakima system.

Adult (4 year old) returns	
Total adult return (4's + 5's) to Prosser	3,783
plus adult harvest below Prosser	321
Total return of adult (4's + 5's) to system	4,104
Adults to Roza[a]	2,125
plus 237 (spawning below Roza)[b]	237
plus 361 (harvest above Prosser)[c]	361
Total adults to Yakima[d]	2,723
Adults to Naches[e]	1,198
plus 183 (harvest above Prosser)[f]	183
Total adults to Naches	1,381
times 50% (4 year old fish)[g]	691
Total four year old returns to system	3,414
plus jacks that returned in 1984	248
plus five year old returns in 1986[h]	2,440
Total 3, 4, and 5 year old returns	6,102
minus hatchery fish	90
Total wild 3, 4, and 5 year old returns	6,012
Wild smolts outmigrating in 1983	135,548
Survival $(S_{sa}) = \frac{6,102}{135,548} =$	4.4%

[a] Total adults counted at Roza fish ladder.
[b] Spring chinook calculated to spawn in Yakima River below Roza dam from 91 redds at 2.6 fish/redd = 237 fish.
[c] Estimate of percentage of 544 spring chinook that were harvested above Prosser and below Roza that would have gone up Yakima. Based on 66.3% of adult run returning to the Yakima and 33.7% to Naches.
[d] Estimated that 100% of the adults in the Yakima are four year old fish.
[e] Estimated as total return of adults to system minus adult count at Roza minus spawning below Roza minus harvest between Prosser and Roza.
[f] Estimate of percentage of 544 fish harvested above Prosser and below Roza that would have returned to the Naches system (33.7%).
[g] Estimated that 50% of the adults in the Naches system are four year old fish.
[h] From Table 28.

Table 27. Estimation of smolt to adult survival of the 1984 smolt outmigration from the Yakima system.

Adult (4 year old) returns	
Total adult return (4's + 5's) to Prosser	8,563
plus adult harvest below Prosser	530
Total return of adult (4's + 5's) to system	9,093
Adults to Roza[a]	2,967
plus 706 (spawning below Roza)[b]	706
plus 504 (harvest above Prosser)[c]	540
Total adults to Yakima[d]	4,213
Adults to Naches[e]	4,610
plus 270 (harvest above Prosser)[f]	270
Total adults to Naches	4,880
times 50% (4 year old fish)[g]	2,440
Total four year old returns to system	5,163
plus jacks that returned in 1984	423
plus five year old returns in 1987[h]	963
Total 3,4, and 5 year old returns	6,549
minus hatchery fish	30
Total wild 3, 4, and 5 year old returns	6,519
Wild Smolts outmigrating in 1984	123,732
Survival $(S_{sa}) = \frac{6,519}{123,732} =$	5.3%

[a]Total adults counted at Roza fish ladder.
[b]Spring chinook calculated to spawn in Yakima River below Roza dam from 321 redds at 2.2 fish/redd = 706 fish.
[c]Estimate of percentage of 544 spring chinook that were harvested above Prosser and below Roza that would have gone up Yakima. Based on 66.7% of adult run returning to the Yakima and 33.3% to Naches.
[d]Estimated that 100% of the adults in the Yakima are four year old fish.
[e]Estimated as total return of adults to system minus adult count at Roza minus spawning below Roza minus harvest between Prosser and Roza.
[f]Estimate of percentage of 810 fish harvested above Prosser and below Roza that would have returned to the Naches system (33.3%).
[g]Estimated that 50% of the adults in the Naches system are four year old fish.
[h]From Table 28.

Table 28. Estimation of smolt to adult survival of the 1985 smolt outmigration from the Yakima system.

Adult (4 year old) returns	
Total adult return (4's + 5's) to Prosser	3,683
plus adult harvest below Prosser	222
Total return of adult (4's + 5's) to system	3,905
Adults to Roza[a]	1,610
plus 237 (spawning below Roza)[b]	253
plus 361 (harvest above Prosser)[c]	115
Total adults to Yakima[d]	1,978
Adults to Naches[e]	1,868
plus 183 (harvest above Prosser)[f]	57
Total adults to Naches	1,925
times 50% (4 year old fish)[g]	963
Total four year old returns to system	2,941
plus jacks that returned in 1984	349
Total 3 and 5 year old returns	3,290
minus hatchery fish	245
Total wild 3, 4, and 5 year old returns	3,045
Wild smolts outmigrating in 1985	
Survival (S_{sa}) = $\frac{3,045}{83,614}$ =	4.4%

[a] Total adults counted at Roza fish ladder.
[b] Spring chinook calculated to spawn in Yakima River below Roza dam from 125 redds at 2.02 fish/redd = 253 fish.
[c] Estimate of percentage of 174 spring chinook that were harvested above Prosser and below Roza that would have gone up Yakima. Based on 66.3% of adult run returning to the Yakima and 33.7% to Naches.
[d] Estimated that 100% of the adults in the Yakima are four year old fish.
[e] Estimated as total return of adults to system minus adult count at Roza minus spawning below Roza minus harvest between Prosser and Roza.
[f] Estimate of percentage of 544 fish harvested above Prosser and below Roza that would have returned to the Naches system (33.7%).
[g] Estimated that 50% of the adults in the Naches system are four year old fish.

6.2 HATCHERY OPERATIONS

6.2.1 OUTPLANTING STUDIES

6.2.1.1 Smolt releases

To evaluate the effectiveness of rearing and releasing hybrids and acclimating fish in earthen ponds and then allowing for a volitional release as smolts, three groups of spring chinook smolts were released from Mary's pond at RM 192 on the Yakima River and a forth group was transported from Leavenworth National Fish Hatchery and scatter-planted directly into the upper Yakima River between RM 155 and 200. The release data for the 1987 acclimation pond and river-released groups of smolts is presented in Table 29.

Similar releases were made from Nile Springs pond and the upper Yakima River in 1983 and 1984 and from Mary's pond and the upper Yakima River in 1985 to compare acclimation ponds vs. direct river releases. The 1986 release groups represented the first time the wild x wild and wild x hatchery hybrids were released. The 1987 release groups were a repetition of the 1986 releases. The survival of these release groups to Prosser is discussed extensively in the smolt trapping section of this report. The 1983 release groups returned as six year old adults in 1987 and the 1984 release groups returned as four year old adults in 1986 and five year old adults in 1987. The 1985 release groups returned as four year old fish in 1987. Their survival rates will be discussed in the Hatchery Adult Return section of this report.

Table 29. Rearing, marking and release data for acclimated and non-acclimated experimental spring chinook releases in 1987.

	Hatchery stock acclimated	Hatchery stock non-acclimated	Hybrid acclimated	Native acclimated
Brood stock	Carson	Carson	Carson-Yakima cross	Yakima-Yakima cross
Rearing site	Leavenworth N.F.H.	Leavenworth N.F.H.	Leavenworth N.F.H.	Leavenworth N.F.H.
Rearing facility	raceway	raceway	raceway	raceway
Release type	volitional from pond	trucked	volitional from pond	volitional from pond
Release site	Mary's pond[a]	Upper Yakima River[b]	Mary's pond[a]	Mary's pond[a]
Release date	April 14	April 14	April 14	April 14
Total number released	50,519	50,113	52,392	56,841
Number branded	5,040	5,040	5,240	5,640
Percent branded	10.0	10.1	9.6	9.9
Brand code[c]	LPI1(1-4)	RAI1(1-4)	LAIL(1-4)	LAIL(1-4)
Date branded	10-1-86	10-1-86	10-1-86	10-1-86
Number with ad-CWT	42,436	42,796	44,899	47,576
Tag code	5-17-38 5-17-56	5-17-38 5-17-56	5-17-55	5-14-46 5-14-47 5-14-48
Tag retention	84.8%	85.4%	85.7%	83.7%
Size at release	124 mm 20.6/lb	125 mm 19.9/lb	130 mm 17.2/lb	129 mm 17.1/lb

[a]Located RM 144.9, Yakima River.
[b]Ellensburg-Cle Elum area, median release point RM 118, Yakima River.
[c]The brand code was rotated from 1 to 4 with 25% of the total release group branded in each of the four positions.

6.2.2 BROOD STOCK EVALUATIONS

An experimental brood stock program was undertaken in 1984 and continued in 1985 to evaluate the effectiveness of using spring chinook adults from the Yakima River as a source of gametes for hatchery reared fish in an attempt to maintain the genetic components indigenous to the Yakima Basin. Crosses were made to obtain four different release groups; wild males and wild females, wild males and hatchery females, and two groups of hatchery males and females. The first three groups were released in acclimation ponds and the fourth group was released directly into the Yakima River and compared with survival of group three - a continuation of the acclimation pond vs. river release study. The required crosses were made in 1984 and 1985 from Yakima River brood stock adults taken from the Roza adult trap. The hybrids were reared at Leavenworth National Fish Hatchery and released as smolts. The first releases, the 1984 brood year products, were made from Mary's pond and the upper Yakima in 1986. The resulting progeny of the 1985 crosses were released at the same locations in 1987. Survival of each release group was calculated at Prosser smolt trap for smolt survival. The survival to returning adults will be determined for each group through 1990 when the five year old adults from the 1987 smolt releases return to the river.

6.2.3 ADULT HATCHERY RETURNS

Spring chinook adults from fourteen different hatchery

release groups were recovered in 1987. These fish were identified by the coded wire tags recovered in the Yakima Indian Nation Zone 6 ceremonial and subsistance fishery, the Yakima River ceremonial dipnet fishery, from spawning ground surveys and carcass recovery surveys conducted on the Yakima and Naches River systems in August, September and October of 1987, and from the adult trap at Roza Dam. A total of 149 fish were inspected for adipose fins and coded wire tags in the Naches River in 1987. All fish passing Roza Dam were inspected for adipose clips. Any clipped fish were sacrificed to increase the the recovery of coded wire tags. Table 30 presents the release data for all hatchery groups that could possibly return to the Yakima system as three, four, five or six-year-old fish in 1987 (two six year old adults were found in 1987).

Table 30. Tag data on all hatchery release groups that could have returned to the Yakima system in 1987.

Brood year	Tag code	Total number released	Release site	Number tagged	Mark rate (%)
1981	5-13-38	99,725	Nile Springs	94,529	94.8
1981	5-13-39	97,725	Upper Yakima	94,198	97.1
1982	5-11-47	29,636	Nile Springs	28,450	96.0
1982	5-11-48	45,552	Upper Yakima	41,573	97.7
1983	5-15-33	45,195	Marys Pond	43,297	95.8
1983	5-15-32	42,210	Upper Yakima(April)	40,436	95.8
1983	5-15-28	102,837	Upper Yakima(June)	93,064	90.5
1983	5-15-29	102,833	Upper Yakima(Sept.)	93,064	90.5
1983	5-15-30	108,305	Upper Yakima(Nov.)	102,229	94.4
1983	5-12-23	25,794	Rattlesnake	40,434	87.0
1984	5-15-45	100,750	Upper Yakima(June)	96,216	95.5
1984	5-15-46	101,724	Upper Yakima(Sept.)	95,621	94.0
1984	5-15-47	101,522	Upper Yakima(Nov.)	95,431	94.0
1984	5-15-48	50,657	Upper Yakima	46,858	92.5
1984	5-15-49	51,846	Mary's Pond(H)	47,076	90.8
1984	5-15-50	46,476	Mary's Pond(HxW)	40,434	87.0
1984	5-15-51	33,052	Mary's Pond(WxW)	29,449	89.1

The 1987 tag recoveries were from the 1983 upper Yakima release group; the 1984 Nile Springs pond and upper Yakima groups; the June, September and November 1984 and 1985 fry and pre-smolt release groups and the 1985 and 1986 Mary's pond release groups. The expanded recoveries for each of the release groups is presented in table 31.

Table 31. Estimated expanded returns of hatchery released smolts.

Tag code	Source of recovery[a]	Number recovered	Sample rate[b,c]	Sample expanded	Mark rate	Total recovery
5-13-39	4	2	1.00	2	.971	2
5-11-47	3	2	0.10	20	.960	21
5-11-48	4	5	1.00	5	.977	5
5-15-28	4	23	1.00	23	.905	25
5-15-29	4	32	1.00	32	.905	35
5-15-30	4	41	1.00	41	.944	43
5-15-32	4	37	1.00	37	.958	39
5-15-33	4	58	1.00	58	.958	61
5-15-46	4	3	1.00	3	.940	3
5-15-47	4	1	1.00	1	.940	1
5-15-49	4	1	1.00	1	.908	1
5-15-50	4	3	1.00	3	.870	3
5-15-51	4	1	1.00	1	.891	1
5-15-23	5	2	0.16	13	.966	13

[a] Recovery code 1 = Zone 6 ceremonial and subsistence fishery; 2 = Yakima River dipnet fishery; 3 = Naches spawner and carcass surveys; 4 = Yakima River Roza fish trap; 5=Rattlesnake Creek spawner surveys.
[b] In the Naches system 145 fish were inspected from an estimated 1,485 spawners.
[c] In the Rattlesnake 10 fish were inspected from an estimated 62 spawners.

The 1987 adults returning from the 1983 upper Yakima release groups were six-year-old fish, and complete the data necessary to calculate the smolt to adult survival rate for these two hatchery release groups.

An analysis of the 1983 upper Yakima River release group indicates that 2 six-year-old adults returned in 1987, 12 five-year old adults returned in 1986 and 31 four-year-old fish returned in 1985. The total estimated adult return was thus 45 fish. There were 97,725 smolts released in the upper Yakima in 1983. This gives a "smolt-at-release" to adult survival rate of 0.05%. It was estimated that 20,131 of these smolts survived passage to Prosser Dam in 1983. The smolt-at-Prosser to adult survival rate was thus 0.22%. This compares to a "smolt-at-release" to adult survival rate of 0.08% and "smolt-at-Prosser" rate of 0.2% for the Nile pond acclimation release group.

Survival rates for smolt-at-Prosser to adult are almost identical between the acclimated and non-acclimated 1983 release groups. The survival rate from release site to Prosser, however, was almost twice as great for the acclimated fish (38.5%) as for the non-acclimated fish (20.6%). Thus, acclimation and volitional release apparently increased the relative fitness of acclimated smolts, perhaps by allowing recovery from the stress of handling and transportation and/or the development of adaptive behavior patterns (e.g., predator avoidance responses).

In 1987 we recovered coded wire tags from five year old

fish from both the 1984 release group at Nile Springs pond and the 1984 upper Yakima River release group. An expanded total of 21 fish were estimated to have returned from the Nile Springs acclimation pond release. This give a total of 40 returning adults (19 in 1986) for this release group. The survival from smolt at release (29,636 smolts) for this acclimation pond release was therefore 0.13%. It was estimated that 16,063 or 54.2% of these smolts survived to Prosser smolt trap. This gives a "smolt-at-Prosser" to adult survival rate of 0.25%.

A total of five upper Yakima River release group adults were recovered as five year old adults in 1987. Added to the 12 adults returning from this release group in 1986 gives a total of 17 adults from the river release.

A total of 45,552 smolts were released in this experimental group. That gives a "smolt-at-release" survival rate to adult of 0.04%. These smolts survived to Prosser at 32.7% rate which give 14,896 smolts and a "smolt-at-Prosser" to adult survival rate of 0.11%.

Five other release groups had more than three returning adults in 1987. All five groups were from the 1985 smolts outmigration and thus were returning as four year old adults in 1987. These five release groups were the 1984 pre-smolt release groups of June fry (25 adults returned), September pre-smolts (35 adults), and November pre-smolts (43 adults), and the 1985 smolt release from Mary's pond (61 adults) and the upper Yakima River releases (32 adults). Since each of these groups could have five year old adults return in 1988 the analysis of percent

smolt to adult survival will not be undertaken in this annual report.

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Appendix A.

Prosser Diversion dam trap adult counts

April, 1987--July, 1987

and

Roza diversion dam trap adult counts

May, 1987--September, 1987.

Appendix Table A.1. Prosser diversion dam adult trap count for April 1987.

	Right bank trap				Center trap				Cumulative passage			
Date	Chinook adults	Chinook jacks	Chinook total	Steelhead	Chinook adults	Chinook jacks	Chinook total	Steelhead	Chinook adults	Chinook jacks	Chinook total	Steelhead
04/01/87	0	0	0	7	0	0	0	5	0	0	0	2356
04/02/87	0	0	0	6	0	0	0	11	0	0	0	2373
04/03/87	0	0	0	2	0	0	0	7	0	0	0	2382
04/04/87	0	0	0	9	0	0	0	5	0	0	0	2396
04/05/87	0	0	0	6	0	0	0	5	0	0	0	2407
04/06/87	0	0	0	2	0	0	0	1	0	0	0	2410
01/07/87	0	0	0	4	0	0	0	2	0	0	0	2416
04/08/87	0	0	0	3	0	0	0	0	0	0	0	2419
04/09/87	0	0	0	3	0	0	0	0	0	0	0	2422
04/10/87	0	0	0	1	0	0	0	1	0	0	0	2424
04/11/87	3	0	3	2	0	0	0	1	5	0	5	2427
04/12/87	0	0	0	4	0	0	0	2	5	0	5	2433
04/13/87	0	0	0	1	0	0	0	0	5	0	5	2434
04/14/87	3	0	3	3	1	0	1	4	9	0	9	2441
04/15/87	3	0	3	3	1	0	1	4	13	0	13	2450
04/16/87	8	0	8	8	5	0	5	3	26	0	26	2461
04/17/87	5	0	5	1	1	0	1	0	32	0	32	2462
04/18/87	6	0	6	2	0	0	0	0	38	0	38	2464
04/19/87	23	0	23	0	0	0	0	2	61	0	61	2466
04/20/87	6	0	6	0	0	0	0	0	67	0	67	2466
04/21/87	15	0	15	0	6	0	6	0	88	0	88	2466
04/22/87	16	0	16	0	8	0	8	0	112	0	112	2466
04/23/87	18	0	18	2	0	0	0	0	130	0	130	2468
04/24/87	3	0	3	0	0	0	0	3	133	0	133	2471
04/25/87	20	0	20	1	5	0	5	3	158	0	158	2475
04/26/87	32	0	32	3	6	0	6	2	196	0	196	2480
04/27/87	50	0	50	1	17	0	17	0	263	0	263	2481
04/28/87	92	0	92	1	9	0	9	0	364	0	364	2482
04/29/87	86	6	92	2	18	0	18	0	468	6	474	2484
04/30/87	99	10	109	0	23	0	23	0	590	16	606	2484
Monthly total	488	16	504	79	100	0	100	61	588	16	606	140
Seasonal total[a]					420	0	420	2208	420		420	2208

Appendix Table A.2. Prosser diversion dam adult trap count for May 1987.

	Right bank trap				Center trap				Cumulative passage			
Date	Chinook adults	Chinook jacks	Chinook total	Steelhead	Chinook adults	Chinook jacks	Chinook total	Steelhead	Chinook adults	Chinook jacks	Chinook total	Steelhead
05/01/87	42	1	43	0	5	0	5	0	637	17	654	0
05/02/87	12	0	12	0	6	0	6	0	655	17	672	0
05/03/87	31	0	31	0	7	2	9	0	693	19	712	0
05/04/87	126	7	133	3	3	0	3	2	822	26	848	5
05/05/87	114	10	124	1	6	0	6	0	942	36	978	6
05/06/87	144	69	213	0	19	1	20	0	1105	106	1211	6
05/07/87	93	21	114	0	63	0	63	0	1261	0	0	6
05/08/87	64	8	72	0	0	0	0	0	1325	135	1460	6
05/09/87	115	1	116	0	21	0	21	0	1461	136	1597	6
05/10/87	137	3	140	0	0	0	0	0	1978	139	1737	6
05/11/87	152	2	154	0	20	0	20	0	1770	141	1911	6
05/12/87	158	4	0	22	34	2	36	8	1912	147	2109	6
05/13/87	236	7	243	0	32	0	32	0	2230	154	2384	6
05/14/87	177	4	181	0	46	5	51	0	2453	163	2616	6
05/15/87	33	2	35	0	5	0	5	0	0	165	2656	6
05/16/87	35	4	39	0	6	6	0	0	2532	169	2701	6
05/17/87	55	13	68	0	33	0	33	0	2620	182	2802	6
05/18/87	88	15	103	0	42	3	45	0	2750	200	2950	6
05/19/87	79	13	92	0	23	3	26	0	2850	216	3068	6
05/20/87	107	16	123	0	12	1	13	0	2971	233	3204	6
05/21/87	82	5	87	0	3	0	3	0	3056	238	3294	6
05/22/87	43	3	45	0	9	0	9	0	3109	241	3349	6
05/23/87	21	4	25	0	2	0	2	0	3131	245	3376	6
05/24/87	41	12	53	0	32	0	32	0	3204	257	3461	6
05/25/87	33	12	45	0	18	4	22	0	3255	273	3528	6
05/26/87	49	8	57	0	21	2	23	0	3325	283	3608	6
05/27/87	18	1	19	0	5	3	8	0	3348	287	3635	6
05/28/87	14	2	16	0	2	0	2	0	3364	289	3653	6
05/29/87	2	3	5	0	0	0	0	0	3366	292	3658	6
05/30/87	25	1	26	0	6	0	6	0	3397	293	3690	6
05/31/87	33	4	37	0	4	0	4	0	3434	297	3731	6
Monthly total	2359	255	2614	4	485	26	26	511	2844	2810	3125	6
Seasonal total[a]	3242	229	3471	3	3716	7	3723	6	6958	236	7194	9

[a]Spring chinook (start of counting to 07/31), fall chinook (08/01 - 12/31), summer steelhead (08/01 - 05/01).
n/o = Not operating.

Appendix Table A.3. Prosser diversion dam adult trap count for June 1987.

	Right bank trap				Center trap				Cumulative passage			
Date	Chinook adults	Chinook jacks	Chinook total	Steelhead	Chinook adults	Chinook jacks	Chinook total	Steelhead	Chinook adults	Chinook jacks	Chinook total	Steelhead
06/01/87	15	4	19	0	6	0	6	1	3472	301	3756	0
06/02/87	17	4	21	0	0	1	1	0	3472	306	3778	0
06/03/87	26	4	30	0	5	1	6	0	3503	311	3814	0
06/04/87	9	2	11	0	3	0	3	0	3515	313	3828	0
06/05/87	11	2	13	0	2	0	3	0	3828	315	3843	0
06/06/87	8	0	8	0	0	0	0	0	3536	315	3851	0
06/07/87	27	3	30	0	2	0	2	4	3565	318	3883	0
06/08/87	25	3	28	0	0	0	0	2	3590	321	3911	0
06/09/87	6	0	6	0	0	0	0	1	3596	321	3917	0
06/10/87	11	1	12	0	0	0	0	0	3612	324	3936	0
06/11/87	11	1	12	0	0	0	0	0	3607	322	3929	0
06/12/87	0	0	0	3	0	0	0	1	3612	324	3936	2185
06/13/87	3	0	3	0	0	0	0	1	3615	324	3939	0
06/14/87	3	2	5	0	0	0	0	5	3618	326	3944	0
06/15/87	4	0	4	0	1	0	0	0	3618	326	3949	0
06/16/87	1	0	1	0	0	0	0	0	3623	326	3950	0
06/17/87	2	0	2	0	0	0	0	0	3624	326	3952	0
06/18/87	1	0	1	0	1	0	1	0	3626	326	3954	0
06/19/87	2	0	2	0	0	0	0	0	3630	326	3956	0
06/20/87	4	0	4	0	1	0	1	0	3635	326	3961	0
06/21/87	9	3	12	0	1	0	1	0	3645	326	3974	0
06/22/87	5	0	5	0	0	0	0	0	3650	329	3979	0
06/23/87	6	0	6	0	2	0	2	0	3658	329	3987	0
06/24/87	2	0	2	0	0	0	0	0	3660	329	3989	0
06/25/87	1	0	1	0	0	0	0	0	3661	329	3990	0
06/26/87	1	1	2	0	0	0	0	0	3662	330	3992	0
06/27/87	2	0	2	0	0	0	0	0	3664	330	3994	0
06/28/87	3	0	3	0	0	0	0	2	3667	330	3997	0
06/29/87	1	0	1	0	0	0	0	0	3668	330	3998	
06/30/87	0	0	0	0	0	0	0	0	3668	330	3998	8
Monthly total	210	31	241	0	24	2	24	0	234	33	267	0
Seasonal total[a]	3242	229	3471	3	3716	7	3723	6	6958	236	7194	9

[a]Spring chinook (start of counting to 07/31), fall chinook (08/01 - 12/31), summer steelhead (08/01 - 05/01).
n/o= Not operating.

Appendix Table A.4. Prosser diversion dam adult trap count for July 1987.

	Right bank trap				Center trap				Cumulative passage			
Date	Chinook adults	Chinook jacks	Chinook total	Steelhead	Chinook adults	Chinook jacks	Chinook total	Steelhead	Chinook adults	Chinook jacks	Chinook total	Steelhead
07/01/87	0	0	0	0	0	0	0	0	3668	330	3998	0
07/02/87	0	0	0	0	0	0	0	0	3668	330	3998	0
07/03/87	0	0	0	1	0	0	0	0	3669	330	3999	0
07/04/87	0	0	0	0	0	0	0	0	3669	330	3999	0
07/05/87	0	0	0	0	0	0	0	0	3669	330	3999	1
07/06/87	0	0	0	0	0	0	0	0	3669	330	3999	0
07/07/87	0	0	0	0	0	0	0	0	3669	330	3999	0
07/08/87	7	1	8	1	0	0	0	0	3676	331	4007	1
07/09/87	0	0	0	4	0	0	0	0	3676	331	4007	5
07/10/87	2	2	4	1	0	0	0	0	3678	333	4011	6
07/11/87	0	0	0	0	0	0	0	0	3678	333	4011	6
07/12/87	0	0	0	0	2	1	3	1	3680	334	4014	7
07/13/87	1	0	1	1	0	0	0	0	3681	334	4015	8
07/14/87	0	0	0	0	0	0	0	0	3681	334	4015	8
07/15/87	0	1	1	5	0	0	0	0	3681	335	4016	13
07/16/87	0	0	0	2	0	0	0	0	3681	335	4016	15
	0	0	0	0	0	0	0	0	3681	335	4016	15
07/18/87	0	0	0	0	0	0	0	0	3681	335	4016	15
07/19/87	0	0	0	0	0	0	0	0	3681	335	4016	15
07/20/87	0	0	0	0	0	0	0	0	3681	335	4016	15
07/21/87	0	0	8	1	0	0	0	0	3681	335	4016	16
07/22/87	0	0		0		0		0	3681		4016	16
07/23/87	1	0	1	2	8	0	0	0	3682	335	4017	18
07/24/87	1	0	1	1	0	0	0	0	3683	335	4018	19
07/25/87	0	0	0	0	0	0	0	0	3683	335	4018	19
07/26/87	0	0	0	0	0	0	0	0	3683	335	4018	19
		0					0					19
07/28/87	0	0	0	0	0	0	0	0	3683	335	4018	19
07/29/87	0	0	0	0	0	0	0	0	3683	335	4018	19
07/30/87	0	0	0	0	0	0	0	0	3663	335	4018	19
07/31/87	0	0	0	0	0	0	0	0	3683	335	4018	19
Monthly total	13	4	17	1a	2	1	3	1	15	5	20	12
Seasonal total[a]	0	0	0	0	3716	7	3723	6	6958	236	7194	9

[a]Spring chinook (start of counting to 07/31), fall chinook (08/01 - 12/31), summer steelhead (08/01 - 05/01).
n/o = Not operating.

Appendix Table 1.5. Roza Diversion Dam counts for May 1987.

	DAILY COUNTS					CUMULATIVE COUNTS					PERCENT CONTRIBUTION	
	WILD		HATCHERY			WILD		HATCHERY				
DATE	ADULTS	JACKS	ADULTS	JACKS	TOTAL	ADULTS	JACKS	ADULTS	JACKS	TOTAL	WILD	HATCHERY
01-May	0	0	0	0	0	0	0	0	0	0	100.0	0.0
02-May	0	0	0	0	0	0	0	0	0	0	100.0	0.0
03-May	0	0	0	0	0	0	0	0	0	0	100.0	0.0
04-May	0	0	0	0	0	0	0	0	0	0	100.0	0.0
05-May	1	0	0	0	1	1	0	0	0	1	100.0	0.0
06-May	1	0	0	0	1	2	0	0	0	2	liJo.o	0.0
07-May	0	0	0	0	0	2	0	0	0	2	100.0	0.0
08-May	4	0	1	0	5	6	0	1	0	7	85.7	14.3
09-May	4	0	1	0	5	10	0	2	0	12	83.3	lb.7
10-May	14	0	1	0	15	24	0	3	0	27	98.9	11.1
11-May	10	0	0	0	10	34	0	3	0	37	91.9	8.1
12-May	14	0	2	0	16	48	0	5	0	53	90.6	9.4
13-May	6	0	1	0	7	54	0	*b*	0	60	90.0	10.0
14-May	*11*	0	4	0	15	65	0	10	0	75	86.7	13.3
15-May	9	0	2	0	11	74	0	12	0	86	86.0	14.0
16-May	19	0	3	0	22	93	0	15	0	108	86.1	13.9
17-May	10	1	1	0	12	103	1	lb	0	120	86.7	13.3
18-May	64	0	8	0	72	167	1	24	0	192	87.5	12.5
19-May	38	1	10	0	49	205	2	34	0	241	85.9	14.1
20-May	57	3	3	0	63	262	5	37	0	304	87.8	12.2
21-May	70	7	8	0	85	332	12	45	0	389	88.4	11.6
22-May	04	2	5	0	91	416	14	50	0	480	89.6	10.4
23-May	49	5	2	0	56	465	19	52	0	*536*	*90.3*	9.7
24-May	55	5	3	0	63	520	24	55	0	599	90.8	9.2
25-May	195	6	18	1	222	715	32	73	1	621	91.0	9.0
26-May	40	2	9	1	52	755	34	82	2	073	90.4	9.6
27-May	24	1	5	0	30	779	35	87	2	903	90.1	9.9
Xl-Hay	14	I	3	0	18	793	36	90	2	921	90.0	10.0
29-May	22	0	3	0	25	815	36	93	2	946	90.0	10.0
30-May	63	4	7	0	74	873	40	100	2	1020	90.0	10.0
31-May	28	3	3	0	34	906	43	103	2	1054	90.0	10.0
Total	906	43	103	2	1054							

Gppendix Table A.6. Roza Diversion Dam counts for June 1987.

	DAILY COUNTS				CUMULATIVE COUNTS						PERCENT CONTRIBUTION	
	WILD		HGTCHERY			WILD		HGTCHERY				
DATE	ADULTS	JACKS	ADULTS	JACKS	TOTGL	ADULTS	JACKS	ADULTS	JACKS	TOTAL	WILD	HATCHERY
01-Jun	30	0	e	0	38	936	43	111	2	1092	89.7	10.3
02-Jun	23	1	7	0	31	959	44	118	2	1123	89.3	10.7
03-Jun	50	4	b	0	60	1009	48	124	2	1183	89.3	10.7
04-Jun	47	1	1	0	49	1056	49	125	2	1232	89.7	10.3
05-Jun	33	4	5	0	42	1089	53	130	2	1274	89.6	10.4
Ob-Jun	13	0	4	0	17	1102	53	134	2	1291	89.5	10.5
07-Jun	20	0	1	0	21	1122	53	135	2	1312	89.6	10.4
OB-Jun	15	0	1	0	16	1137	53	136	2	1328	89.6	10.4
09-Jun	20	0	4	0	24	1157	53	140	2	1352	89.5	10.5
10-Jun	16	1	2	0	19	1173	54	142	2	1371	89.5	10.5
11-Jun	25	1	4	0	30	1198	55	146	2	1401	89.4	10.6
12-Jun	34	2	3	0	39	1232	57	149	2	1440	89.5	10.5
13-Jun	2	1	1	0	4	1234	58	150	2	1444	89.5	10.5
14-Jun	7	0	1	0	B	1241	58	151	2	1452	89.5	10.5
15-Jun	16	1	2	0	19	1257	59	153	2	1471	89.5	10.5
lb-Jun	8	0	1	0	9	1265	59	154	2	1480	89.5	10.5
17-Jun	5	1	0	0	b	1270	60	154	2	1486	89.5	10.5
18-Jun	12	1	2	0	15	1282	61	156	2	1501	89.5	10.5
19-Jun	21	0	7	0	28	1303	61	163	2	1529	89.2	10.8
20-Jun	11	0	11	0	22	1314	61	174	2	1551	88.7	11.3
21-Jun	5	0	1	0	6	1319	61	175	2	1557	88.6	11.4
22-Jun	1	0	3	0	4	1320	61	178	2	1561	88.5	11.5
23-Jun	5	0	2	0	7	1325	bl	180	2	1568	88.4	11.6
24-Jun	6	0	0	0	6	1331	61	180	2	1574	88.4	11.6
25-Jun	13	0	5	1	19	1344	61	185	3	1593	88.2	11.8
26-Jun	11	0	11	0	22	1355	bl	196	3	lb15	87.7	12.3
27-Jun	B	0	1	0	9	1363	61	197	3	1624	87.7	12.3
28-Jun	20	0	3	0	23	1383	61	200	3	1647	87.7	12.3
29-Jun	15	1	1	0	17	1398	62	201	3	1664	87.7	12.3
30-Jun	9	0	3	1	13	1407	62	204	4	1677	87.6	12.4
Total	501	19	101	2	623							

Appendix Table A.7. Roza Diversion Dam counts for July 1987.

	DAILY COUNTS					CUMULATIVE COUNTS					PERCENT CONTRIBUTION	
	WILD		HATCHERY			WILD		HATCHERY				
DATE	ADULTS	JACKS	ADULTS	JACKS	TOTAL	ADULTS	JACKS	ADULTS	JACKS	TOTAL	WILD	HATCHERY
01-Jul	5	0	1	0	*b*	1412	b2	205	4	1683	*87.6*	12.4
02-Jul	9	0	0	0	9	1421	62	205	4	lb92	*87.6*	12.4
03-Jul	7	0	0	0	7	1428	b2	205	4	1699	87.7	12.3
04-Jul	6	0	1	1	8	1434	b2	206	5	1707	87.6	12.4
05-Jul	7	0	0	0	7	1441	62	206	5	1714	87.7	12.3
Ob-Jul	2	0	0	0	2	1443	*b2*	206	5	1716	87.7	12.3
07-Jul	2	0	2	0	4	1445	62	208	5	1720	*07.6*	12.4
08-Jul	2	0	2	0	4	1447	62	210	5	1724	87.5	12.5
09-Jul	2	0	0	0	2	1449	62	210	5	*1726*	*07.5*	12.5
IO-Jul	1	0	1	0	2	1450	b2	211	5	1720	87.5	12.5
1l-Jul	3	0	1	0	4	1453	62	212	5	1732	07.5	12.5
12-Jul	2	0	0	0	2	1455	42	212	5	*1734*	*87.5*	12.5
13-Jul	4	1	2	0	7	1459	b3	214	5	1741	87.4	12.6
14-Jul	b	0	0	0	b	1465	63	214	5	1747	87.5	12.5
15-Jul	2	0	3	0	5	1467	63	217	5	1752	87.3	12.7
16-Jul	11	0	2	1	14	1478	*b3*	219	6	1766	*B7.3*	12.7
17-Jul	6	0	0	0	*b*	1484	63	219	6	1772	87.3	12.7
18-Jul	*b*	0	1	0	7	1490	63	220	6	1779	87.3	12.7
19-Jul	3	0	0	1	4	1493	63	220	7	1783	87.3	12.7
20-Jul	1	0	0	0	1	1494	63	220	7	1784	87.3	12.7
21-Jul	9	0	3	0	12	1503	*b3*	223	7	1796	87.2	12.8
22-Jul	1	0	0	1	2	1504	63	223	8	1798	87.2	12.8
23-Jul	2	0	0	0	2	1506	b3	223	8	1800	87.2	12.8
24-Jul	7	0	1	0	8	1513	63	224	8	1808	87.2	12.8
25-Jul	5	0	2	0	7	1518	63	*226*	a	1815	87.1	12.9
26-Jul	0	0	0	0	0	1518	*b3*	226	a	1815	87.1	12.9
27-Jul	2	1	0	0	3	1520	64	22b	a	1818	87.1	12.9
28-Jul	3	0	1	0	4	1523	64	227	8	1822	87.1	12.9
29-Jul	0	0	0	0	0	1523	64	227	8	1822	87.1	12.9
30-Jul	2	0	0	0	2	1525	64	227	8	1824	87.1	12.9
31-Jul	0	0	0	0	0	1525	64	227	8	la24	87.1	12.9
Total	118	2	23	4	147							

Apoendix Table A.8. Roza Diversion Dam c o u n t s for August 1987.

	DAILY COUNTS					CUMULATIVE COUNTS					PERCENT CONTRIBUTION	
	WILD		HATCHERY			WILD		HATCHERY				
DATE	ADULTS	JACKS	ADULTS	JACKS	TOTAL	ADULTS	JACKS	ADULTS	JACKS	TOTAL	WILD	HATCHERY
01-Aug	2	0	1	0	3	1527	64	228	8	1827	67.1	12.9
02-Aug	0	0	0	0	0	1527	64	228	a	1827	87.1	12.9
03-Aug	1	0	1	0	?	1528	64	229	8	1829	87.0	13.0
04-Aug	4	0	1	0	5	1532	64	230	a	1834	87.0	13.0
05-Aug	4	0	1	0	5	1536	64	231	8	1839	87.0	13.3
06-Aug	0	0	0	0	0	1536	64	231	a	1839	87.1,	13.0
07-Aug	2	0	3	0	5	1538	64	234	a	la44	86.9	13.i
08-Aug	2	1	2	0	5	1540	65	236	8	1849	86.8	13.2
09-Aug	1	0	0	0	1	1541	65	236	a	1850	86.8	13.2
10-Aug	3	0	0	0	3	1544	65	236	8	1853	86.8	13.2
11-Aug	6	0	0	0	6	1550	65	236	a	la59	86.9	13.1
12-Aug	0	0	0	0	0	1550	65	236	a	1859	86.9	13.1
13-Aug	4	0	1	0	5	1554	65	237	8	1864	86.9	13.1
14-Aug	1	0	1	0	2	1555	65	238	8	1866	86.8	i3.2
15-Aug	4	0	0	0	4	1559	65	238	8	1870	86.8	13.2
Ib-Aug	1	0	1	0	2	1560	65	239	a	1872	86.8	13.2
17-Aug	1	0	0	0	1	1561	65	239	8	1873	86.8	13.2
18-Aug	4	0	0	0	4	1565	65	239	a	1877	86.8	13.2
19-Aug	2	0	1	0	3	1567	65	240	a	1880	86.8	13.2
20-Aug	4	0	0	0	4	1571	65	240	8	la64	86.8	13.2
21-Aug	2	0	0	0	2	1573	65	240	8	1886	Flb.9	13.1
22-Aug	0	0	0	0	0	1573	65	240	8	1886	86.9	13.1
23-Aug	1	0	0	0	1	1574	65	240	a	1887	86.9	13.1
24-Aug	0	0	0	0	G	1574	65	240	8	1887	86.9	13.i
25-Aug	3	2	0	0	5	1577	67	240	8	1892	86.9	1'.1'
26-Au3	0	0	0	0	0	1577	67	240	a	1892	86.9	13.1
27-Aug	2	0	2	0	4	1579	67	24Z	a	1896	86.8	13.2
28-Aug	2	0	0	0	2	1581	67	242	a	1898	86.8	13.2
29-Aug	3	0	0	0	3	1584	67	242	a	1901	86.8	13.2
30-Aug	1	0	0	0	1	1585	67	242	8	1902	66.9	13.1
31-Aug	1	0	1	0	2	1586	67	243	a	1904	86.8	13.2
Total				0	80							

Appendix Table A.9. Roza Diversion Dar counts for September 1987.

	DAILY COUNTS					CUMULATIVE COUNTS					PERCENT CONTRIBUTION	
	WILD		HATCHERY			WILD		HATCHERY				
DATE	ADULTS	JACKS	ADULTS	JACKS	TOTAL	ADULTS	JACKS	ADULTS	JACKS	TOTAL	WILD	HATCHERY
01-Sep	0	0	0	0	0	1586	67	243	8	1904	86.8	13.2
02-Sep	5	0	0	0	5	1591	67	243	8	1909	06.9	13.1
03-Sep	7	0	1	0	8	1598	67	244	8	1917	86.9	13.1
04-Sep	0	0	0	0	0	1598	67	244	8	1917	86.9	13.1
05-Sep	1	0	0	0	1	1599	67	244	8	1918	86.9	13.1
06-Sep	0	0	0	0	0	1599	67	244	8	1918	86.9	13.1
07-Sep	1	0	0	0	1	1600	67	244	8	1919	86.9	13.1
08-Sep	1	0	0	0	1	1601	67	244	8	1920	86.9	13.1
09-Sep	3	0	1	0	4	1604	67	245	8	1924	86.9	13.1
10-Sep	3	0	0	0	3	1607	67	245	8	1927	86.9	13.1
11-Sep	0	0	0	0	0	1607	67	245	8	1927	86.9	13.1
12-Sep	1	0	0	0	1	1608	67	245	8	1928	86.9	13.1
13-Sep	1	0	0	0	1	1609	67	245	8	1929	86.9	13.1
14-Sep	0	0	0	1	1	1609	67	245	9	1930	86.8	13.2
15-Sep	0	0	0	0	0	lb09	67	245	9	1930	86.8	13.2
lb-Sep	0	0	0	0	0	1609	67	245	9	1930	86.8	13.2
17-Sep	0	0	0	0	0	1609	67	245	9	1930	86.8	13.2
18-Sep	0	0	0	0	0	1609	67	245	9	1930	86.8	13.2
19-Sep	0	0	0	0	0	1609	67	245	9	1930	86.8	13.2
20-Sep	0	0	0	0	0	1609	67	245	9	1930	86.8	13.2
21-Sep	0	0	0	0	0	1609	67	245	9	1930	86.8	13.2
22-Sep	0	0	0	0	0	1609	67	245	9	1930	86.8	13.2
23-Sep	0	0	0	0	0	1609	67	245	9	1930	86.8	13.2
24-Sep	0	0	0	0	0	1609	67	245	9	1930	86.8	13.2
25-Sep	1	0	0	0	1	1610	67	245	9	1931	86.8	13.2
26-Sep	0	0	0	0	0	1610	67	245	9	1931	86.8	13.2
27-Sep	0	0	0	0	0	1610	67	245	9	1931	86.8	13.2
28-Sep	0	0	0	0	0	1610	67	245	9	1931	86.8	13.2
29-Sep	0	0	0	0	0	1610	67	245	9	1931	86.8	13.2
30-Sep	0	0	0	0	0	1610	67	245	9	1931	86.8	13.2
Total	24	0	2	1	27							

Appendix B.

Prosser smolt outmigration counts.

November, 1986--July, 1987

Appendix Table 9.1. Prosser smolt outmigration for November, 1986.

DRY	WSCHK	HURTS	WFCHK	MORTS	HSCHK	MORTS	HFCHK	MORTS	WSTH	MORTS	HSTH	MORTS	NELS	NACH	COHO	MORTS	TROUT	WAPPA	HRIV	HPOND	WILD	HYBRID
1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
10	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
11	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
14	522	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	282	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	8	0	0	0	0
16	416	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	4	0	0	0	0
17	797	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	6	0	0	0	0
18	430	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0
19	195	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
20	122	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	0	0
21	19	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	46	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	138	3	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	81	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	53	3	0	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
29	40	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0
30	63	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	3242	13	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	26	0	0	0	0

Appendix Table B.3.--Prosser smolt outmigration for January, 1997.

DAY	WSCHK	WMORTS	WFCHK	WMORTS	WSCHK	WMORTS	WFCHK	WMORTS	WSTH	WMORTS	WSTH	WMORTS	WELS	WNACH	WCOHO	WMORTS	WTROUT	WAPPA	WHRIV	WPOND	WILD	HYBRID
1	88	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	7	0	0	0	0
2	146	0	6	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3	0	0	0	0
3	160	0	4	0	0	0	0	0	1	0	0	0	0	0	0	0	0	7	0	0	0	0
4	91	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3	0	0	0	0
5	177	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
6	177	0	12	0	0	0	0	0	1	0	0	0	0	0	0	0	0	5	0	0	0	0
7	104	1	8	0	0	0	0	0	2	0	0	0	0	0	0	0	0	3	0	0	0	0
8	152	0	9	0	0	0	0	0	2	0	0	0	0	0	0	0	0	4	0	0	0	0
9	114	0	19	0	0	0	0	0	1	0	0	0	0	0	0	0	0	5	2	0	0	0
10	117	1	8	0	0	0	0	0	1	0	0	0	0	0	0	0	0	5	4	0	0	0
11	162	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	2	0	0	0
12	573	1	54	0	0	0	0	0	2	0	0	0	0	0	0	0	0	37	0	0	0	0
13	785	6	26	0	0	1	0	0	2	0	0	0	0	0	0	0	0	27	1	0	0	0
14	604	0	18	0	0	0	0	0	1	0	0	0	0	0	0	0	0	18	2	0	0	0
15	615	17	41	0	0	1	0	0	2	0	0	0	0	0	0	0	0	34	10	1	0	0
16	599	46	115	0	0	0	0	0	1	0	0	0	0	0	0	0	0	27	24	0	0	0
17	462	0	97	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	18	0	0	0
18	473	0	49	0	0	0	0	0	1	0	0	0	0	0	0	0	0	19	2	0	0	0
19	498	0	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	1	0	0	0
20	546	0	39	0	0	0	0	0	1	0	0	0	0	0	0	0	0	22	44	0	0	0
21	542	0	48	0	0	0	0	1	0	0	0	0	0	0	0	1	0	21	5	0	0	0
22	401	34	59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	52	0	0	0
23	427	209	74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	46	0	0	0
24	376	187	65	0	0	0	0	0	1	0	0	0	0	0	0	0	0	12	24	0	0	0
25	407	117	55	0	0	0	0	0	4	0	0	0	0	0	0	0	0	14	24	0	0	0
26	315	160	50	0	0	0	0	0	2	0	1	0	0	0	0	0	0	6	9	0	0	0
27	383	108	3	0	0	0	0	0	5	0	0	0	0	0	0	0	0	17	8	0	0	0
28	217	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0
29	142	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0
30	77	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
Total	9970	891	0	0	2	0	0	0	12	1	0	0	0	0	0	0	0	393	1	0	0	0

Appendix Table B.4. Prosser smolt outmigration for February, 1987.

DAY	WSCHK	MORTS	WFCHK	MORTS	HSCHK	MORTS	HFCHK	MORTS	WSTH	MORTS	HSTH	MORTS	NELS	NACH	COHO	MORTS	TROUT	WAPPA	HRIV	HPOND	WILD	HYBRID
1	147	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
2	2497	1	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	26	0	0	0	0
3	4044	18	0	0	0	0	0	0	361	1	0	0	0	0	3	0	0	60	0	0	0	0
4	298	0	0	0	0	0	0	0	481	0	0	0	0	0	0	0	0	9	0	0	0	0
5	336	0	0	0	0	0	0	0	413	0	2	0	0	0	0	0	0	2	0	0	0	0
6	251	1	0	0	0	0	0	0	348	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1050	0	0	0	0	0	0	0	885	0	0	0	0	0	0	0	0	0	0	0	0	0
8	2724	353	0	0	0	0	0	0	32	1	0	0	0	0	0	0	0	30	0	0	0	0
9	126	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	1	0	0	0	0
10	---	---	---	---	---	---	---	---	- -	---	---	---	---	---	---	---	---	---	---	---	---	---
11	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
14	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
15	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1b	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
17	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
18	---	---	---	---	---	---	---	- -	---	---	---	---	---	---	---	---	---	---	---	---	---	---
19	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
20	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
21	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
22	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
23	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
24	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
25	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
26	---		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
27	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
28	---	---	---	---	---	---	---	---	- -	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	11473	374	0	0	0	0	0	0	2533	2	2	0	0	0	3	0	0	130	0	0	0	0

Appendix Table B.5. Prosser smolt outmigration for March, 1 9 8 7

DAY	WSCHK	MORTS	WFCHK	MORTS	HSCHK	MORTS	HFCHK	MORTS	WSTH	MORTS	HSTH	MORTS	NELS	NACH	CDHO	MORTS	TROUT	WAPPA	HRIV	HPOND	WILD	HYBRID
1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
9	195	0	0	3	0	0	0	0	3287	1	0	0	0	0	0	0	0	0	0	0	0	0
10	12	0	0	0	0	0	0	0	133	0	0	0	0	0	0	0	0	0	0	0	0	0
11	100	0	0	0	0	0	0	0	427	2	0	0	0	0	0	0	0	0	0	0	0	0
12	50	0	0	0	0	0	0	0	248	0	0	0	0	0	0	0	0	0	0	0	0	0
13	242	0	0	0	0	0	0	0	1117	0	0	0	0	0	0	0	0	0	0	0	0	0
14	990	0	0	0	0	0	0	0	2240	1	0	0	0	0	0	0	0	0	0	0	0	0
15	541	0	0	0	0	0	0	0	1010	0	0	0	0	0	0	0	0	10	0	0	0	0
16	882	0	0	0	0	0	0	0	1710	0	0	0	0	0	0	0	0	11	0	0	0	0
17	741	0	0	0	0	0	0	0	1417	0	0	0	0	0	0	0	0	0	0	0	0	0
18	520	0	0	0	0	0	0	0	1137	0	0	0	0	0	0	0	0	0	0	0	0	0
19	422	0	0	0	0	0	0	0	57a	0	0	0	0	0	0	0	0	1	0	0	0	0
20	224	0	0	0	0	0	0	0	264	0	0	0	0	0	0	0	0	6	0	0	0	0
21	217	1	0	0	0	a	0	0	411	0	0	0	0	0	0	0	0	5	0	0	0	0
22	166	0	0	0	0	0	0	0	230	0	0	0	0	0	0	0	0	0	0	0	0	0
23	261	1	0	0	0	0	0	0	239	2	0	0	0	0	0	0	0	0	0	0	0	0
24	248	0	0	0	9	0	0	0	182	0	0	0	0	0	0	0	0	3	0	0	0	0
25	272	0	0	0	0	0	0	0	125	0	7	0	0	0	0	5	0	0	0	0	0	0
26	191	1	0	0	0	0	0	0	97	0	4	0	0	0	2	0	0	0	0	0	0	0
27	220	0	0	0	0	0	0	0	115	0	,	0	0	0	0	0	0	0	0	0	0	0
28	241	2	0	0	9	0	0	0	127	0	3	9	0	0	0	0	0	9	0	0	0	0
29	lb!	0	0	0	1	0	0	0	78	0	0	0	0	0	0	0	0	1	0	0	0	0
30	126	0	0	0	3	0	0	0	63	0	0	0	0	0	1	0	0	0	0	0	0	0
31	140	1	0	0	5	0	0	0	81	0	1	0	0	0	1	0	0	0	0	0	0	0
Total	7232	6	0	0	27	0	0	0	15316	6	17	0	0	0	4	0	0	52	0	0	0	0

Appendix Table B.6. Prosser smolt outmigration for April, 1987.

DAY	WSCHK	MORTS	WFCHK	MORTS	HSCHK	MORTS	HFCHK	MORTS	WSTH	MORTS	HSTH	MORTS	NELS	NACH	COHO	MORTS	TROUT	WAPPA	HRIV	HPOND	WILD	HYBRID
1	305	5	1	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2	582	1	2	0	b	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0
3	2970	0	9	0	20	2	0	0	0	0	0	0	9	0	0	0	0	20	0	0	0	0
4	7410	0	22	0	40	1	0	0	0	0	0	0	0	0	0	0	0	54	0	0	0	0
5	5536	0	17	0	42	0	0	0	0	0	13	0	0	0	0	0	0	123	0	0	0	0
6	2360	21	7	0	61	0	0	0	0	1	0	0	0	0	0	0	0	33	0	0	0	0
7	2224	13	7	0	82	1	0	0	0	0	8	0	0	0	0	0	6	42	0	0	0	0
8	3650	11	15	0	122	0	0	0	0	2	5	0	0	0	25	6	0	12	0	0	2	0
9	4033	41	16	0	75	1	0	0	682	2	34	0	21	11	28	0	0	19	0	0	0	0
10	5758	8	23	0	202	1	0	0	b?0	1	93	0	86	8	29	0	0	82	0	0	4	2
11	4342	b	17	0	129	0	0	a	558	10	73	1	58	13	8	0	0	76	0	2	3	3
12	3550	0	14	0	75	0	0	0	425	3	62	1	56	4	4	0	1	4b	0	0	1	1
13	3296	1	13	0	47	0	0	0	461	0	74	1	70	4	3	0	0	41	1	1	0	0
14	8017	10	32	0	124	0	0	0	733	2	100	0	90	10	17	0	0	111	0	9	1	0
15	8950	16	45	0	160	0	0	0	563	0	58	0	51	7	20	0	0	172	0	0	3	0
16	14036	16	71	0	327	1	0	0	967	0	b1	1	55	5	59	0	0	255	0	13	4	6
17	13037	10	66	0	505	0	0	0	2923	1	122	0	101	22	151	0	0	299	2	17	5	3
18	6121	45	31	0	559	0	0	0	2244	0	144	3	119	25	103	0	0	76	16	4	10	6
19	2647	36	13	0	1292	0	0	0	1472	1	103	0	a2	20	183	0	0	27	141	4	4	0
20	3115	1	16	0	1039	19	0	0	993	2	93	0	78	15	149	0	0	57	104	3	4	1
21	3358	30	17	0	691	18	0	0	663	1	91	0	76	14	127	0	0	78	79	1	5	1
22	7158	11	1374	2	1376	1	0	0	1160	9	94	0	81	12	245	0	0	120	94	28	7	0
23	8214	54	1576	10	1220	2	0	0	1196	2	99	0	87	10	294	0	0	119	118	5	11	4
24	4591	60	881	12	1053	4	0	0	857	1	111	0	86	22	402	0	1	40	118	1	13	4
25	6725	56	1292	11	1249	9	0	0	1814	2	137	0	109	27	586	0	1	74	117	1	9	6
26	4238	a4	813	16	1199	6	0	0	1489	0	96	0	b7	29	784	0	0	41	91	12	20	0
27	4296	70	807	14	969	1	0	0	1589	0	120	0	99	21	753	1	13	21	76	0	6	3
28	4403	108	845	21	1086	22	0	0	1400	b	95	0	80	15	B72	0	21	15	75	3	8	3
29	10242	56	1965	11	2086	16	0	0	3784	15	230	5	177	50	16b43	3	32	65	96	5	11	3
30	40782	638	7826	122	14661	217	0	0	13178	44	5204	12	4083	1096	28200	16b3	148	204	557	13	126	26
Total	195866	1408	17833	219	30500	322	0	0	39838	95	7320	41	5812	1443	34685	173	223	2324	1685	122	257	72

Appendix Table B.7. **Prosser smolt outmigration** for **May**, 1987.

DAY	WSCHK	HURTS	UFCHK	MORTS	HSCHK	MORTS	HFCHK	MORTS	WSTH	MORTS	HSTH	MORTS	NELS	NACH	COHO	MORTS	TROUT	0	HRIV	HPOND	WILD	HYBRID
1	6194	19	bbao	20	3176	1	0	0	4755	0	1314	2	956	353	3667	1	0	0	161	0	38	13
2	4948	0	5337	0	2808	0	0	0	2869	0	469	0	360	154	1208	0	0	0	15	8	0	0
3	553	0	596	1	1020	0	0	0	331	0	61	0	61	0	23b	0	0	0	7	0	14	7
4	629	0	679	0	1773	3	0	0	788	1	111	0	81	30	692	1	0	0	5	5	15	6
5	1033	I	1114	1	3582	0	0	0	944	0	244	6	269	35	1003	0	0	0	b	9	26	9
6	3779	48	4076	52	5154	6	8	0	1289	2	356	0	257	97	1123	2	0	12	34	14	61	I?
7	3712	3	4004	3	2186	I	298	0	1511	2	391	2	202	97	1726	1	6	2	33	10	25	8
8	5115	12	lb962	38	6447	13	464	0	5541	16	2675	9	2033	612	7967	1	30	21	53	15	95	15
9	2701	11	a957	36	2719	4	2827	4	4745	7	5162	2	2857	2264	23444	15	51	31	0	0	26	16
10	1597	14	5295	44	299	2	3841	28	949	0	732	1	306	426	17911	5	0	6	0	0	0	6
11	1020	0	3381	1	54	0	2269	6	507	6	293	I	lb2	132	8760	0	0	6	0	0	0	0
12	172	I	2561	3	134	0	1779	1	368	2	268	6	130	78	7775	3	52	0	0	0	9	6
13	903	I	2995	5	97	1	1051	6	565	1	282	6	213	69	6991	5	116	0	0	0	5	0
14	706	1	2341	4	202	I	1404	0	b95	6	423	1	183	239	13080	4	155	0	0	0	5	0
15	713	0	2749	0	269	2	1025	2	790	1	365	1	264	101	6373	2	87	0	0	6	0	0
lb	585	5	2179	19	10	0	2318	0	239	2	144	b	53	91	7945	7	6	6	0	6	6	0
17	533	4	2654	14	34	0	1818	17	817	4	204	6	162	102	5524	lb	lb	0	0	0	2	0
18	539	8	2079	29	lb	1	1948	43	261	1	127	0	46	81	3567	17	1	0	0	0	0	0
19	371	0	1431	2	11	0	1531	0	252	6	114	6	37	78	4722	0	0	0	6	6	0	0
20	118	1	453	b	5	0	414	lb	214	0	117	0	55	62	3168	13	22	0	0	6	6	0
21	243	1	938	4	9	0	879	4	34b	0	191	0	120	70	3630	7	4	0	0	6	6	0
22	259	2	886	9	29	I	1122	14	532	6	465	4	239	22b	7126	25	22	2	0	0	4	0
23	377	11	1287	37	156	0	1307	22	1061	13	1025	9	536	489	6445	20	54	6	6	1	13	6
24	320	2	1395	5	42	0	1266	6	352	0	259	2	126	146	33ab	7	14	0	1	1	1	0
25	706	I	2414	3	13	0	2793	4	576	6	289	6	138	151	3457	3	4	1	6	0	0	0
26	562	5	1919	18	49	I	1631	7	747	7	253	lb	151	162	2192	48	10	0	0	6	1	0
27	556	1	1899	3	53	0	1682	9	781	4	234	4	80	155	lb45	8	17	2	0	6	0	6
28	377	4	1290	15	22	0	1135	7	610	2	198	I	64	134	1173	8	5	1	0	0	2	6
29	429	7	1465	22	26	6	979	17	810	17	229	lb	91	138	1197	77	23	6	0	0	0	0
36	589	I	2014	5	10	0	2091	4	543	0	309	0	151	158	2718	16	0	1	0	0	0	6
31	243	3	829	10	10	0	718	7	243	2	91	2	38	53	460	12	4	6	0	0	6	0
Total	41162	167	91959	411	30439	34	38603	212	35045	78	17215	79	10255	6856	162245	324	693	73	255	63	342	74

Appendix Table B.8. Prosser smolt outmigration for June, 1987.

DAY	WSCHK	MORTS	WFCHK	MORTS	HSCHK	MORTS	HFCHK	MORTS	WSTH	MORTS	HSTH	MORTS	NELS	NACH	COHO	MORTS	TROUT	WAPPAL	HRIV	HPOND	WILD	HYBRID
1	lb8	0	1282	0	8	0	977	0	682	0	175	0	54	122	460	0	9	0	0	0	0	0
2	141	0	1076	1	6	0	708	0	339	0	83	0	14	b9	176	0	0	0	0	0	1	0
3	94	0	715	3	3	0	448	0	inn	0	73	0	20	53	88	4	1	0	0	0	0	0
4	658	3	5017	22	9	0	2778	20	199	0	125	2	37	88	158	1	4	0	0	0	1	0
5	921	II	7019	85	2	0	5252	68	277	0	119	0	55	64	125	3	3	0	0	0	0	0
6	402	0	3061	0	0	0	1756	0	54	0	87	0	34	53	663	0	7	0	0	0	0	0
7	348	0	2649	1	0	0	1819	0	139	0	31	1	14	17	46	2	1	0	0	0	0	0
8	68	0	1934	0	0	0	2560	0	98	0	56	0	23	34	62	0	0	0	0	0	0	0
9	78	0	2223	8	0	0	2156	4	168	2	34	3	15	18	96	0	4	0	0	0	0	0
10	87	0	2468	4	2	0	1390	0	169	1	51	0	25	27	14	0	0	0	0	0	0	0
11	107	1	3051	24	0	0	1379	1	118	I	45	0	21	24	55	1	3	0	0	0	0	0
12	80	15	2269	437	0	0	937	182	77	4	27	0	11	15	21	11	3	0	0	0	0	0
13	90	0	2417	0	0	0	1049	0	89	0	33	0	14	18	25	0	3	0	0	0	0	0
14	86	0	2188	0	0	0	946	0	80	0	30	0	13	16	24	0	3	0	0	0	0	0
15	a2	0	1951	0	0	0	838	0	72	0	28	0	12	15	20	0	2	0	0	0	0	0
16	78	0	1710	0	0	3	730	0	62	0	25	0	10	14	in	0	2	0	0	0	0	0
17	73	0	1459	0	0	0	617	0	53	0	21	0	9	12	15	0	2	0	0	0	0	0
18	70	0	1218	0	0	0	508	0	45	0	in	0	7	11	13	0	2	0	0	0	0	0
19	66	0	990	0	0	0	405	0	36	0	15	0	6	10	10	0	2	0	0	0	0	0
20	62	0	752	0	0	0	298	0	28	0	13	0	4	8	8	0	1	0	0	0	0	0
21	20	1	150	5	0	0	20	0	4	1	6	0	1	5	2	0	0	0	0	0	0	0
22	45	0	226	1	0	0	33	1	17	0	11	3	3	8	3	0	1	0	0	0	0	0
25	65	53	321	266	0	0	135	127	3	0	3	1	0	3	3	I	1	0	0	0	0	0
24	63	13	317	64	0	0	34	0	10	1	5	4	1	4	1	0	1	0	0	0	0	0
25	61	5	313	27	1	I	7	0	1	0	2	I	0	2	1	0	1	0	0	0	0	0
26	33	0	168	0	0	0	11	0	4	0	2	0	0	2	0	0	1	0	0	0	0	0
27	33	0	168	0	0	0	II	0	4	0	2	0	0	2	0	0	1	0	0	0	0	0
28	6	1	31	8	0	0	4	2	0	0	1	0	0	I	0	0	0	0	0	0	0	0
29	4	0	20	3	0	0	0	0	4	0	1	0	0	I	0	0	1	0	0	0	0	0
30	1	0	7	0	0	0	2	0	1	0	0	0	0	u	0	0	1	0	0	0	0	0
Total	4090	103	47175	959	80	1	27808	405	3021	10	1122	15	403	716	2087	23	60	0	0	0	2	0

Appendix Table B.9. Prosser smolt outmigration for July, 1987.

DAY	WSCHK	MORTS	WFCHK	MORTS	HSCHK	MORTS	HFCHK	MORTS	WSTH	MORTS	HSTH	MORTS	NELS	NACH	COHO	MORTS	TROUT	WAPPAL	HRIV	HPOND	WILD	HYBRID
	0	0	11	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
2	0	0	11	1	0	0	0	0	1	0	1	0	1	0	0	0	2	0	0	0	0	0
3	0	0	24	0	0	0	1	0	0	0	1	0	0	1	0	0	3	0	0	0	0	0
4	0	0	36	0	0	0	1	0	0	0	1	0	0	1	0	0	4	0	0	0	0	0
5	0	0	18	0	0	0	0	0	2	2	0	0	0	0	0	0	1	0	0	0	0	0
6	0	0	62	1	0	0	2	0	0	0	2	0	0	2	0	0	10	0	0	0	0	0
	0	0	34	0	0	0	1	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
8	0	0	35	1	0	0	1	0	1	0	1	0	0	1	0	0	7	0	0	0	0	0
9	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0
10	0	0	29	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0
11	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
12	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
13	0	0	27	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	11	0	0	0	0	0	2	0	0	0	0	0	0	0	3	0	0	0	0	0
15	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
16	0	0	14	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
17	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
18	0	0	22	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
19	0	0	26	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
20	0	0	30	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
21	0	0	29	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
28	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
29	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0
Total	0	0	614	9	0	0	7	0	9	2	7	0	1	6	0	0	60	0	0	0	0	0